SCIENTIFIC AMERICAN

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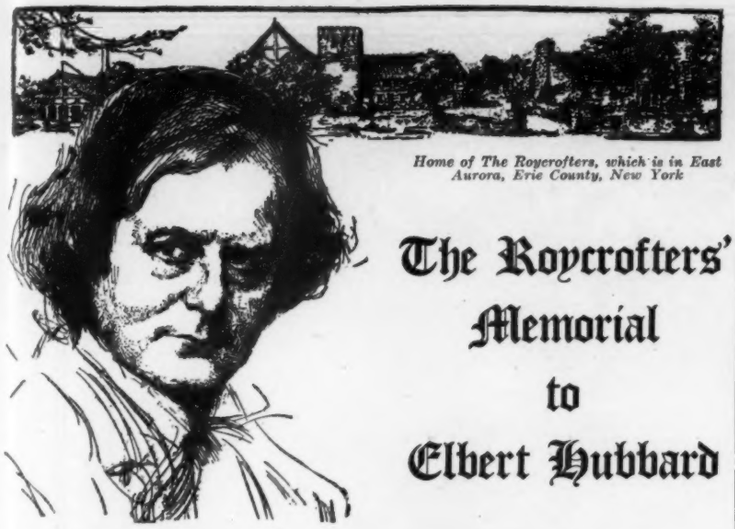
BIRD-LIKE FLIGHT AT LAST: THE SILENT AND GRACEFFUL SOARING GLIDER.—[See page 296]

Scientific American Publishing Co., Munn & Co., New York



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With the Editors

ORDINARILY, an issue of the SCIENTIFIC AMERICAN glides through the editorial and mechanical routine with the precision of well-regulated clockwork. We have a schedule which calls for certain steps in the work to be completed by certain dates, and this ensures a definite date of delivery of the finished copies to the news company which distributes them to the news dealers, as well as to the post office for mailing to our subscribers. But this issue has been the exception; for one cause or another or, to be more truthful, many causes put together, it has been a most obdurate issue to handle. The editorial routine has suffered several setbacks of a minor nature, true, but of sufficient weight to impair the smooth working of the editorial machinery. One little thing after another has come up quite unexpectedly to set us back with our urgent work. As a consequence the schedule has not been maintained. At this point we have just been reminded by one of our staff that this issue is the thirteenth number of the present monthly form! The Editors have never had much patience with superstition; but they are beginning to wonder whether the evil powers commonly attributed to the number thirteen have not some basis of fact. Also, they are trying to establish which member of the staff broke the mirror and walked under the ladder! But then there is but one thirteenth issue, and this is it. With these few lines written and proof-read, number thirteen is finally disposed of once and for all.

THE mechanical details incidental to changing the number of pages after this issue was well under way have brought about a gap in the usual consecutive numbering of the pages. The first page starts out with a folio which represents a gap of four numbers when compared with the preceding issue. Again, there is a gap of four folios toward the rear of the book, but this gap has been rather ingeniously covered over and would perhaps go unnoticed except for our present statement. Still, we point out these unavoidable breaks in the paging at this time, in order to anticipate their discovery by our more critical friends.

IN some respects the scientists and engineers of all nations are engaged with the same broad problems. But in many cases a field which is receiving much attention in France or Germany or Great Britain is comparatively barren in the United States; so that a complete chronicle of what the world is doing requires that a place be reserved for the works of all civilized nations. We have pointed out in this column that our foreign correspondence is today far more inclusive than it has been. Particularly is this the case with Great Britain, the most important fraction of the foreign field. For some years during and after the war we found it a practical impossibility to cover British developments other than by serving them up cold from British papers; and adequate illustration is particularly difficult when an article is thus handled. Our issues of the immediate past and the immediate future, however, feature the work of no less than three very competent British correspondents — Mr. Bywater, who needs no introduction; Mr. Risdon, whose name has appeared quite frequently during the six months just behind us; and Mr. Rowlinson, who is likewise not a complete stranger to our readers. Thanks to the very competent work of these gentlemen, we are now assured that when anything of importance is done in England, we shall have an accurate, first-hand account of it without delay. Still further to strengthen our reportorial work in England, we have arranged with Mr. Clatworthy, a well-known artist of mechanical subjects, to supply us with his elaborate drawings covering European undertakings of surpassing interest.

WHEN we gave Mr. Black's caustic pen the freedom of our pages, we did so with every expectation of receiving plenty of come-backs from the psychics whom he criticizes in no uncertain terms. Most of them are very reasonable, realizing that Mr. Black's articles represent but one viewpoint, and crediting us with the desire to give all sides a fair hearing. In pursuit of this aim, we are going to present in our December issue a representative collection of the comments and criticisms which we have received from Mr. Black's readers. We shall allow Miss Besinnet, of Toledo, to tell why she feels that Mr. Black is unfair in his comments upon her mediumistic performances; we shall allow Dr. Prince, whose July article, "The Psychic Detective," surely acquits him of undue psychic leanings, to tell why he regards Mr. Black as given to inaccuracy; and we shall give space to numerous other letters and portions of letters commenting upon Mr. Black's contribution to the psychic controversy.

IN this issue we present the second and concluding instalment of Mr. Edward H. Smith's interesting account of the constant strife being waged by the safe-builder and the safe-breaker. Our December issue will contain the first instalment of a series on check protection and check alteration. If anything, it is a more interesting story than the safe-breaking story. It deals with the constant matching of inventive minds for the protection of checks and commercial paper on the one hand, and for the raising, forging, and unlawful cashing of such paper on the other. It has a farther-reaching importance, since checks have by now entered into our everyday life, replacing a large amount of currency which was formerly kept in circulation. Mr. Smith, whose specialty is crime and its detection, has several other subjects in mind for our columns. However, we should be highly pleased to hear from our readers regarding the first article which has appeared in this and the preceding issue, before proceeding with several other articles along the same general line.

WITH the coming of cool weather, interest has revived in radio. The radio stocks of the numerous stores handling this line of merchandise are again moving, and the manufacturers are promised a busy season. In view of the meteoric career of radio broadcasting, starting with a popularity which amounted to a craze during last spring, followed by an unexpected slump during the past summer, and again a revival in the fall, it seems well to take inventory of what has been accomplished, what mistakes have been made, what has to be undone, and what is going to happen in the future. This we have done. We have talked the matter over with many men in and out of radio. Their opinions and ours will appear in the December issue.

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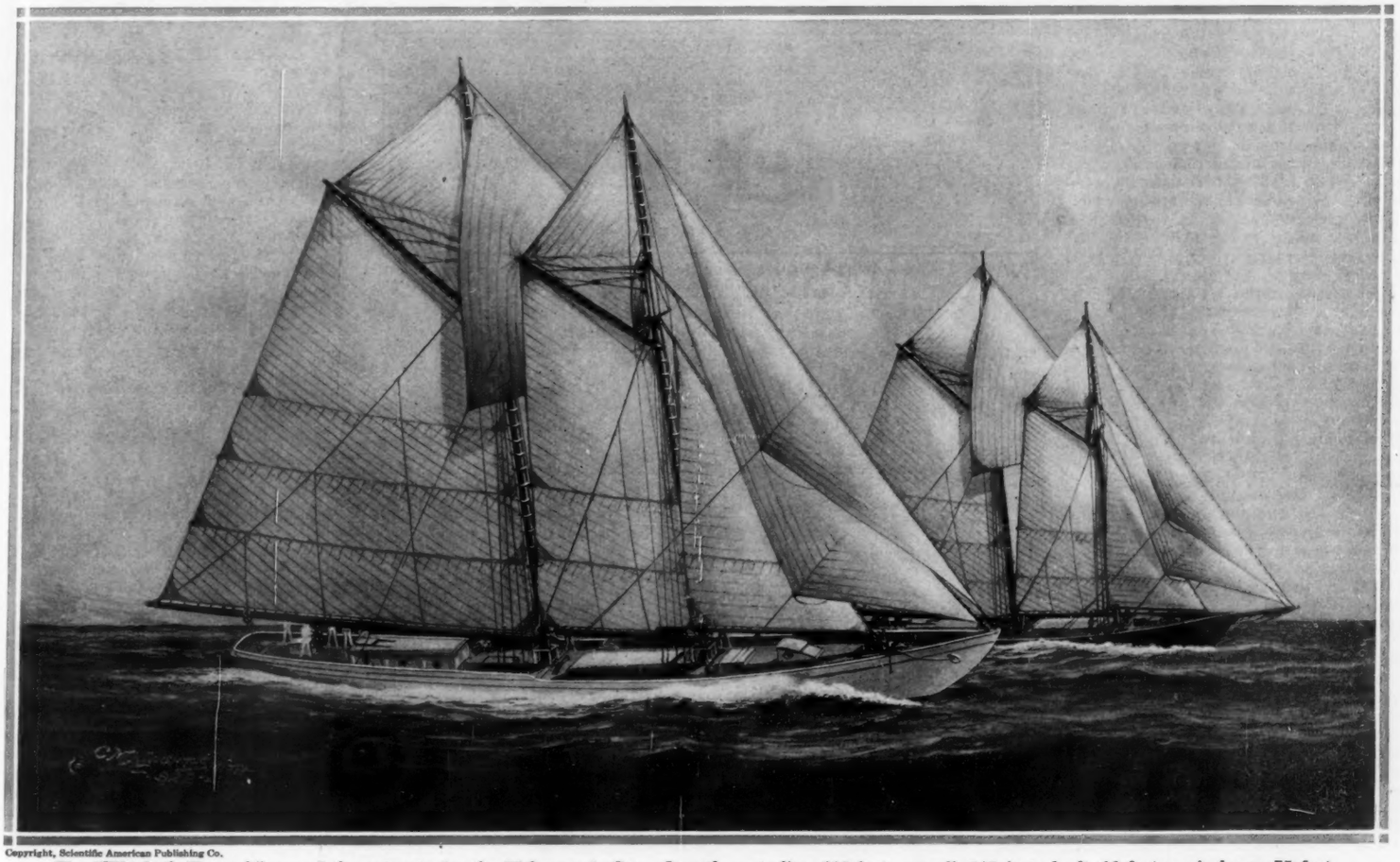
SEVENTY-EIGHTH YEAR

SCIENTIFIC AMERICAN

THE MONTHLY JOURNAL OF PRACTICAL INFORMATION

NEW YORK, NOVEMBER, 1922



The "Elizabeth Howard," one of the entrants for the Fisherman's Cup. Length, waterline, 112 feet; overall, 145 feet; draft, 16 feet; main boom, 75 feet

International Fisherman's Deep-Sea Race

MUCH of the romance of the sea which attended the never-to-be-forgotten period of the famous clipper ships of the middle years of the last century clings today to the doughty schooners which brave the storms and fog and cold of the Newfoundland fishing banks. Stout vessels are these, strongly built in hull, and spreading their heavy canvas sails upon solid spars, that are kept in place by gear that will stand the heaviest weather that the fishing banks can show. Let it not be supposed, however, that because the fishing schooners are so staunchly built they are, therefore, lacking in that fineness of model which is necessary for good speed. On the contrary, in sharpness of entrance and clean run they are comparable to their more dainty sisters, which spread their sails only in the gentler weather which marks the yachting season of the summer months. High speed is as valuable, in its way, to the fishing schooner as to the racing yacht; for when these boats have a full catch of fish aboard there is every inducement for them to make fast time to the ports of the Atlantic coast.

It was two years ago that Mr. Dennis, a newspaper publisher in Halifax, offered a cup for an international race between the vessels of the Grand Banks fleet. The first year Gloucester captured the cup with the schooner "Esperanto," a typical Grand Banks vessel. The Nova Scotian spirit was aroused and several schooners were built and tested, with the result that "Bluenose," a large schooner built up to the full limit of the measurement rules, was selected for the contest. Meanwhile, a Boston syndicate had commissioned Burgess, a noted yacht architect, to design a schooner up to the limit of size, and the result was the "Mayflower," which measures about 112 feet on the waterline, and carries a generous spread of canvas. The racing committee protested the "Mayflower" on the ground that she was not a genuine fishing schooner; that she came from the boards of a yacht designer, and was paid for and owned by yachtsmen. There was the further objection that she did not come within the specification which demands that the contesting boat must have engaged in regular deep-sea fishing off the Grand Banks. The town of Gloucester, nothing discouraged, sent out the "Elsie," an excellent representative of the Grand Banks schooner; but she was of much smaller size than the "Bluenose," and, since size means speed, the venture was somewhat in the nature of a forlorn hope. "Esperanto," the winning schooner of the previous year, had been wrecked on Sable Island; but Captain Welch, who had sailed her to victory, brought the "Elsie" to the line, resolved to give the "Bluenose" a good run for the cup. Down wind, the smaller craft was able to hold the "Bluenose"; but when they brought sheets aboard for a beat back against the wind and sea, the "Elsie" was overpowered, and "Bluenose" won back the cup.

For this year's race a Gloucester syndicate called in Burgess, who designed the "Puritan," an out-and-out fishing schooner which has been at work on the Grand Banks during the past summer. Other new schooners are the "Henry Ford" and the "Yankee"; so that Gloucester would have been well represented. The "Puritan," unfortunately, was wrecked on Sable Island, leaving Gloucester with an entry of only two ships. The racing committee, in view of the fact that the "Mayflower" has been fishing off the Banks this

(Continued on page 361)

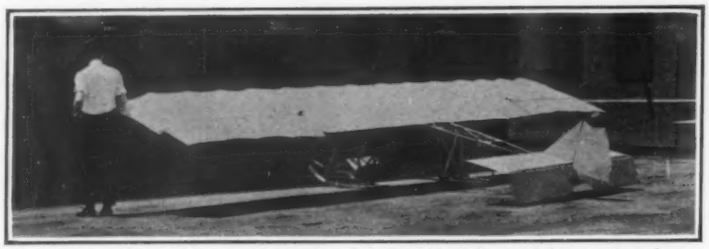
Left: The "Blue Pigeon" of the Landis Brothers after it came to grief at the Clermont-Ferrand contest. *Center:* German monoplane glider in full flight. This machine is of exceptionally light construction as compared with others. *Right:* Gardier glider after its fall at the French meet

Photographic proof that gliding has all the thrills between successful flight and breaking wood on landing

Gliders and Gliding

Recent German and French Gliding Contests and Their Bearing on Aeronautical Progress

AERONAUTICAL history is repeating itself. The recent gliding contests held in Germany and France take us back many years to those all-but-forgotten pioneers in heavier-than-air flight, who essayed gliding flights with far more courage than technical skill. The first attempts were nothing more than gliding flights, which means that the higher is the starting point the longer is the flight. And the flights, made in relatively still air, were timed in seconds.

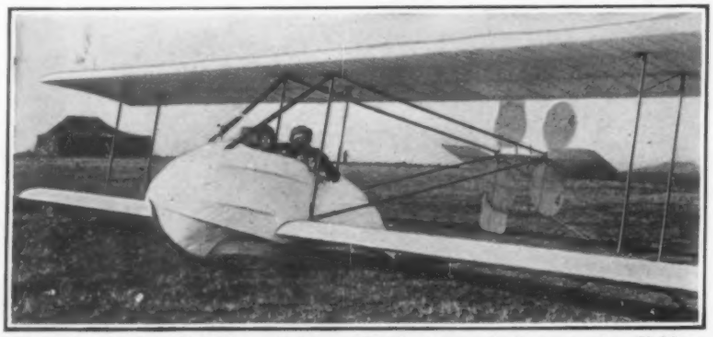


The M. I. T. monoplane glider entered in the French meet by an American college organization

Then came Orville Wright, in October, 1911, with a motorless flight of ten minutes and one second over the sand dunes of Kitty Hawk, N. C. Skipping a decade or more of remarkable development in aviation, with more and more powerful airplanes being developed for warfare and peaceful purposes, we arrive at the present day with a group of young German students making soaring flights of one, two and three hours' duration, which at times are carried to considerably higher altitudes than the starting point. Indeed, it appears as though we have attained soaring flight at last, but on a modest scale to be sure. That we are on the eve of important new developments in heavier-than-air flight, is likewise apparent.

Gliding flight, unlike airplane flight, depends on wind currents. Some wind currents we find everywhere. In a landscape we may find, side by side, a hill, a lake, and a stretch of sandy soil. Given bright sunshine, the sandy soil will heat up more quickly than the rest, the lake will be the coolest portion of the landscape, while the mountain-side will show a slightly higher temperature than the lake. Air current will rise from the warmer parts, as heated air is lighter than cold air; and after having reached a certain height, the air will cool down and return to the cooler section which, in this instance, is the lake. As long as the sunshine lasts, this cycle will be going on, and when night comes it will be reversed, as the sandy soil and hillside will cool down more quickly than the water.

Now if a machine glides down the mountain-side, it will be lifted by the air current rising over the sandy soil. This requires energy, which is here supplied by the air current. Then another glide cannot commence, until another rising current is found. So, by locating rising air currents, the man-bird gains altitude at odd intervals in order to glide down at other times. Just as the bob-sled comes rushing down the hill, so does the glider come down in still air; but in the latter case we have a means of being carried up to the heights again for another glide, whereas with the bob-sled we must climb up the hill.



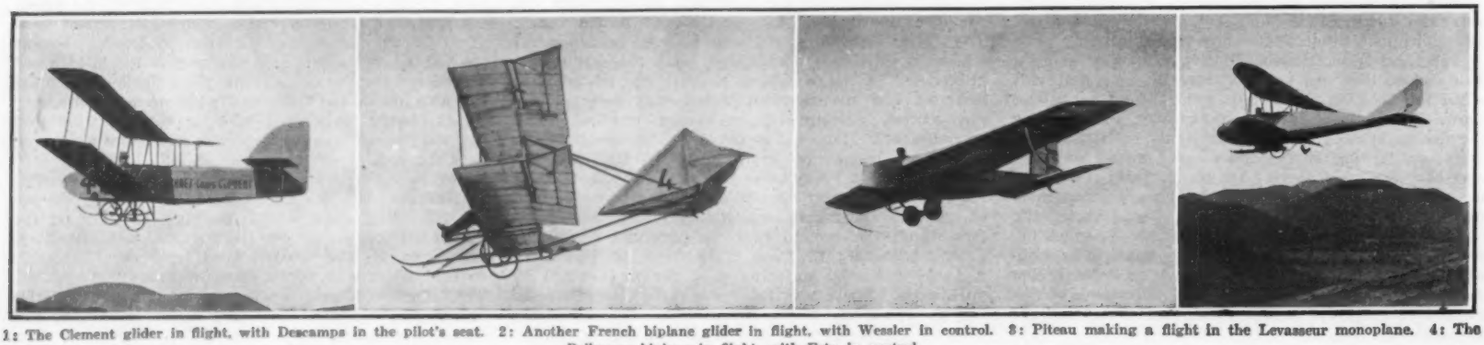
Biplane glider in which the well-known Dutch aeronautical constructor, Fokker, made a flight with a passenger

The great problem in gliding flight, given plenty of rising air currents, is to construct a machine that will hold the air, so to speak, long enough until another favorable upward current is found. This means that the machine must be a good glider—capable of making a good flight in still air, like the coasting bob-sled. To this end the glider must first of all be as light as is possible to build it. Some of the present gliders are real marvels of aeronautical construction; indeed, one of the large German gliders weighs but a trifle over 100 pounds, yet it has a span of 50 feet.

To be a good glider, a machine must also have a wing section of high lift and low resistance. Right here aerodynamic research has helped the German experimenters not a little. Scientists have placed their experience at the disposal of the young German students. Tests after tests were carried out prior to the German contests. In truth, the remarkable flights of Hentzen and Martens have not been due to any queer stroke of luck, but to sound aeronautical engineering methods, a survey of the terrain with regard to wind currents, numerous tests, and other cold technical preliminaries. Apparently, there is no short cut to success, simple as soaring flight may seem.

The gliding efficiency is expressed by the ratio of height of start to length of flight. Supposing a glider with the ratio 1 : 5 started from a hill 300 feet high, in gliding flight only. Without any assistance from wind currents, this machine would come to earth at a distance of 5 x 300, or 1500 feet. Many of the older gliders considered this quite a respectable performance. Today, however, we can build gliders with a gliding efficiency of 1 : 20. Rising from the same hill, 300 feet in height, such a glider would cover a distance 300 x20, or 6000 feet, before landing—something over a mile. It is evident that the present-day glider has a very much better chance of making a soaring flight by finding an upward wind current within the great distance of 6000 feet, than the first machine which could not cover over 1500 feet. For the next upward current, measuring from the starting point, may be perhaps 2000 feet away, and the less efficient glider would be forced to make a landing some 500 feet away from it. Meanwhile the more efficient glider would have covered but a third of its full range of flight; it would then gain new energy or height, and could carry on its flight with a great reserve of height.

Frequently, too, the pilot overlooks an upward current, or notices it too late to make the best use of it; for it must be borne in mind that glider-piloting is still in its infancy. Here again the more efficient glider will score, while the less efficient glider will be forced to land in relatively short order.



1: The Clement glider in flight, with Descamps in the pilot's seat. 2: Another French biplane glider in flight, with Wessler in control. 3: Piteau making a flight in the Levasseur monoplane. 4: The Bellanger biplane in flight, with Fetu in control

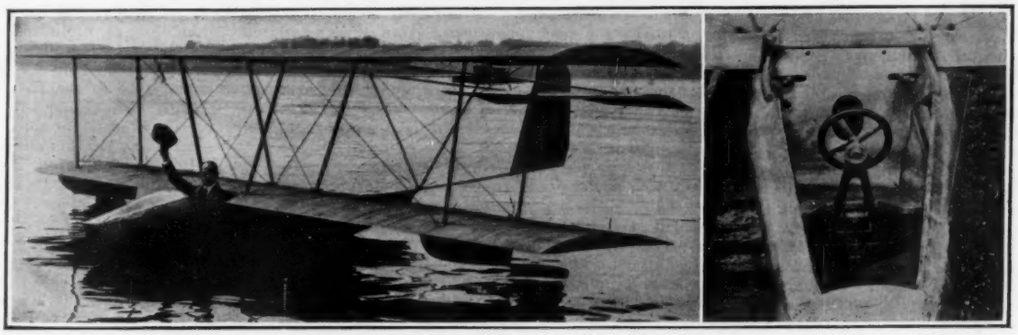
French monoplane and biplane gliders which made short flights at the Clermont-Ferrand meet

In appearance, the successful German gliders resemble most markedly the seagulls, for the investigators acknowledged, or rather had to acknowledge, that we cannot improve on nature's ingenuity. The wings have a very great span, much greater than airplanes of similar capacity; they are narrow; and there is a total absence of parts which might create air resistance, since high resistance reduces the gliding efficiency.

If you have ever watched a seagull soaring, you cannot have failed to notice how it twists the wing tips. This is not only done for the purpose of stability, which means straight flight, but also for turning, for diving, and for climbing. Unfortunately, we do not have at our disposal such a wonderful and light material for wing construction as the feathers of a bird, hence we must do the next best thing with our stiff and inelastic wings. And that means we must turn the wing tips up or down as required. We also make use of a vertical rudder as well as a horizontal rudder or elevator.

Record-breaking flight of Hentzen in the glider "Vampyr" over the hilly Rhön district

Turning from these generalities to the recent gliding contests, we come to the German gliding flights in the Rhön district. This hilly district of western Germany was the scene of last year's gliding contests already described in these columns. In this year's contest Herr Martens first startled the world by a flight of one hour and six minutes, in which he is reported to have sailed over his starting point nine times, while the distance covered in the straight flight with which the performance terminated was one of about six and one-quarter miles. A few days later Herr Hentzen, another young German student, made a flight of two hours, only to surpass that record by a flight of three hours and ten minutes a few days after that. Persons who witnessed the last-mentioned flight, with the motorless machine sailing about among the hills, devoid of sound and with the pilot calling down to those on the ground below, were even more astounded than those of us who read about the remarkable achievement in the daily press. Some even went so far as to suspect that a small motor might be concealed in the German glider, so steadily did the glider keep aloft!



Flying boat glider designed by Glenn H. Curtiss and flown by him at Port Washington, Long Island. The right-hand view shows the cockpit with the steering, elevating and aileron controls

Both Martens and Hentzen in their record-breaking flights used the Hannover "Vampyr" glider, which is the machine used by Martens at last year's meeting, but with some modifications. The 1922 "Vampyr" differs from the 1921 machine in that a warp control is fitted in place of the original ailerons. The wings are of a thick section, of uniform chord for more than half the span, but of considerable taper toward the tips. The wing is mounted on the top of a more or less rectangular section fuselage, which is set with its center line inclined at a large angle to the wings, thus giving a large angle of incidence to the wings when on the ground, tail down, without the need for any projecting undercarriage.

The landing gear consists of three objects resembling footballs in form and construction, except that they are provided with a hole passing through from side to side, to take an axle. The machine has a span of 42 feet 6 inches, a center chord of 4 feet 9 inches, and a wing area of 172 square feet. The weight empty is 264 pounds, while the wing loading is 2.72 per square foot.

Turning from the German flights to the French contest held at Puy de Combegrasse, near Clermont-Ferrand, we find that no less than fifty machines were entered. An impressive array, to be sure; but, as far as results were concerned, the contest could not begin to compare with the Rhön meeting on the other side of the Rhine. The Germans, through previous experience, had learned to avoid freak designs. Nothing is to be gained through a radically different construction; for, after all is said and done, it is pretty well established now that all heavier-than-air machines must follow certain definite lines dictated by well-known aero-dynamic principles. Hence the numerous freak machines entered in the French contest did not fare so well, and curiously enough the machines which did best of all were airplanes with their engine removed. Thus the Farman biplane glider was the Farman "Sport," with the Anzani engine taken out and the pilot's seat moved forward to trim the machine correctly. The same applies to the Farman "Moustique," which normally is a small monoplane, also equipped with an Anzani engine. It will therefore be gathered that both these machines were somewhat heavy, having been designed for the stresses of a power-driven airplane. Nevertheless, Bossoutrot managed to make some very good flights on them, and on several occasions succeeded in gliding over his starting point.

It is interesting to note here the system employed in launching gliders. Use is made of a device called the "sandow"—long elastic cables which are fastened to the glider resting on the ground, and then pulled taut while the glider is held stationary. Three or four men take hold of each cable and start running in the direction of the take-off. At the desired moment the glider is released, and the elastic cables and the crews pulling on them give it a forward sweep. When the glider has left the ground the "sandow" tackle is dropped and the glider is ready for a free flight.

An interesting entry in the French gliding contests was the M. I. T. soaring glider of the Aeronautical Engineering Society of the Massachusetts Institute of Technology. This American glider is of cantilever construction. It has 120 square feet of supporting surface and weighs less than 73 pounds. In flight it has a wing loading of 1.7 pounds per square foot. The wing span is 24 feet, with a chord of 4 feet 9 inches and an aspect ratio of five. The landing gear consists of a pair of skids. The machine, piloted by young Edward Allen, made out quite well and, in fact, had the lead at the beginning of the contest, but was subsequently passed by the French machines.

The longest flight in the French contest was that of the pilot Douchy, who made a flight of nine minutes and two seconds, covering a distance of about five miles and descending some 2700 feet from the summit of the Puy de Dome. The pilot Bossoutrot made a flight of five minutes and eighteen seconds, and was judged the best gliding pilot of the meet, with the greatest total of points covering duration, altitude, slow gliding, precision in landing, and other features to his credit.

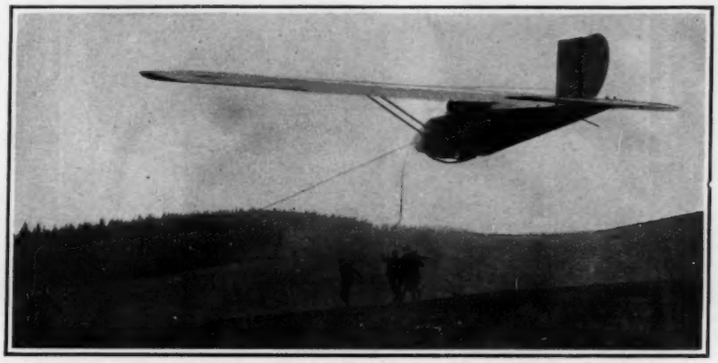
Meanwhile, Glenn H. Curtiss, the well-known American airplane designer and constructor and pioneer airman, has been interesting himself in first-hand gliding experience. Curtiss has constructed a biplane flying boat with a hull of duralumin, wings and control surfaces of the usual wooden construction covered with silk, and with struts of metal tubing. In a recent trial the glider, piloted by Curtiss and given its initial flying speed by a motor boat, made a flight of several seconds. However, there was no wind at the time, and it is estimated that with favorable wind conditions some interesting results will be obtained.

"Our desire is ultimately to emulate the albatross," states Glenn H. Curtiss, "and so to maneuver the motorless glider that it will take off from the surface of the sea. I believe it can be done. At first we shall try launching from the deck of a speed boat or by towing. Our glider is constructed of wood, duralumin and silk. Its dimensions are: Weight (empty), 150 pounds; loaded (one man), 310 pounds; span, 28 feet; chord, 60 inches; gap, 54 inches. Length over all, 22 feet 11 inches; wing area, 267.5 square feet. The glider is designed to fly at 20 miles an hour.

"We are now at a stage in aeronautics in which the buzzard and the albatross appear prominently. The buzzard is a magnificent soarer. In flat country, where the buzzard is most frequently found, air rises from the surface of the earth in waves and sometimes in spirals. Frequently I have watched a buzzard, with marvelous instinct, seek and find 'lodgment' in one of these spirals and thus be literally lifted out of sight.

"Over the water the albatross is king of the air. He is superior even to the buzzard. The buzzard is comparatively lightly loaded, sometimes only one-half pound to each square foot of wing surface. The albatross has a wing loading of more than three pounds a square foot.

"The Germans have very appropriately called their gliders 'sail-planes.' In marine navigation we have developed many types of craft and methods of operation. In the air we have a broader opportunity. By lessening our speed and increasing our load we cheapen air transportation and make it more generally available. Air sailing in three dimensions is certain to be a great sport—especially over water. It may be that 'pedal planes' will supplement sailing for sport, but for practical commercial air transport we shall apply low-powered engines to the sail-planes."



A German monoplane glider taking off by means of the "sandow" device, consisting of elastic cables fastened to the machine and pulled by two ground crews. The cables fall off when the machine gets under way

From Glenn H. Curtiss and other authorities we gather that the problem of soaring flight has been only partially solved. There is no immediate commercial application for gliders, with the possible exception of using them in connection with dirigible flight. Today the great difficulty and expense connected with lighter-than-air travel is in the landing operation, and for that reason a dirigible must fly a long distance between landings. However, it has been pointed out in various quarters that by means of improved, safe gliders, passengers and crew of a

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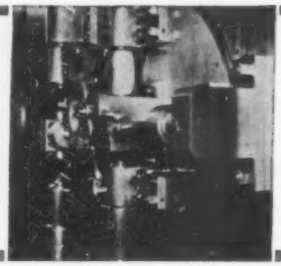


Safes and Safe-Breakers—II

The Present Status of the War Between Safe Builder and Cracksman

By Edward H. Smith

THE TRIUMPH of nitro-glycerine over the safe-maker was not one whose scope was immediately apparent. Neither the burglar nor his opponent understood for some time how complete the disaster was, and manufacturers have never quite admitted the full truth. They did not, in the very nature of things, surrender. Instead they continued to experiment and invent, trying one type of safe after another, but without great success. As each kind of protective box was broken open by the yeggs another and improved variety was offered in its place, and each time the makers uttered great vaunts, perhaps quite honestly. It seems they never really understood the power of nitro or the skill of their criminal antagonists. Safes of ever heavier, stronger and more expensive types came into the market and bankers reluctantly bought and installed them, usually after an older type of safe had been blown in their vicinity. The safe-salesman, of course, followed in the wake of the cracksman. If a bank was robbed in Southern Indiana, let's say, there was a swarm of salesmen in the vicinity within the day, all offering safes that "could not be blown." But a few years passed and one of the "improved" boxes flew open before the puissance of the burglar's soup. So the comedy of the unbreakable safe was acted all over again.

What the technical experts who were trying to devise safes could not do the police attempted. Special precautions were taken against the night-prowling yegg, and bankers' associations organized criminal departments and employed the best private detectives to stamp out safe blowing. In these manners some check was kept upon the yegg, but he extended and enlarged his operations amazingly in the last ten years of the nineteenth century and the first ten of this.

When the yegg first used nitro he continued to direct his attention, as in the old powder days, to small safes in packing houses, ice plants, factories and post offices. These were about as big jobs as he cared to tackle and it was only as he gained experience and learned the full power of his new weapon that he turned his attention to the banks, with their larger and finer strongboxes—and their greater rewards. There were, to be sure, always a few bank robbers among the older men and in the day before nitro, but their operations were limited and occasional.

It is interesting to see the typical yegg gang of ten and twenty years ago at work. A gang or mob consisted usually of three or four members, including a cat kid or young scout. As soon as the use of nitro was well understood and yegging became more safe and profitable, these burglars abandoned their old methods of living. They no longer roved the country as tramps or dressed the part of vagabonds and indigents, as formerly, unless it was done occasionally to delude the police. Instead, the yegg became an extremely well dressed, business-like fellow, living in urban hangouts and often enjoying protection in certain communities that were run by corrupt political rings.

These hangouts were usually saloons with hotel accommodations on the upper floors. The man who ran them was always a minor politician, controlling the vote of a nether city ward. At the same time he was a fence and receiver of stolen goods. He took the stamps which his yeggs had stolen from post offices and converted them into cash, for a 20 per cent commission. If any of the bank notes happened to be torn or scorched as the result of the explosion, he likewise converted them into clean currency for a fee. Again, he was the official fixer for the yeggs who abode under his roof, making arrangements with the local police, passing a share of the proceeds of robberies to local powers and passing the word of alarm to his criminals in case public feeling was about to force police action. Finally, he acted as a professional bondsman, employer of attorneys, banker and lender to the robbing fraternity. He was, in fact, the central figure in the business of safe blowing—and he still exists.

In the hangouts kept by such men the burglar gangs got together, spent the proceeds of their raids, enjoyed the grosser pleasures, and planned their forthcoming robberies. Thence the scouts went out to look for new "marks" to be robbed.

How the Safe-Crackers Work

The leader of a safe-crackers' gang knew enough, after some sad reverses, to stay away from the cities and the bigger banks and confine his operations to smaller communities, mainly towns so insignificant as to employ no night watchman or only a solitary officer, who might be held up, tied, gagged and rendered harmless. Rural regions, where banks in trifling villages were the depositories for a scattered farming population, were the favorite marks. When this captain of burglars wanted a new bank to rob he usually went to a public library and read through the newspapers of the surrounding territory for bank statements, in order to find which banks had plenty of cash on hand. Having made a list of half a dozen possible marks, he sent out his young bronk or scout to look over these various locations and see which offered the best chance of a neat job and sure getaway.

The youthful robber went to the various towns on the regular passenger trains, dressed like a salesman and usually carrying what appeared to be a sample case and sometimes was a kit of tools. The first thing the scout observed was the position of the bank building with reference to the other buildings of the town. He liked a bank that stood off by itself and shied at one located next to the rustic hotel or any other building inhabited at night. When the young marauder found a bank to his liking, he strolled in, asked for change of a large bill, engaged the teller in conversation, went over to the writing desk and jotted down some empty memoranda and meantime let his eye rove all over the place. He noted what kind of safe was in the bank, whether there was a burglar alarm and whether there was a night watchman or rooms overhead in which anyone might be sleeping in the night.

Having satisfied himself in these respects, the scout went out and looked over the town in more detail. He stayed at least a day and a night if conditions were favorable, to find out what the habits of the night policeman might be, how early the citizens were thoroughly asleep, at what hours in the early morning the freight and passenger trains pulled out, what cover the surrounding country offered for an overland getaway and many other details useful to the raiders. Then he sent for the rest of the gang or went back and got them.

The chief of such a gang was usually the man who

Left: The scene of a partially successful bank robbery at Mount Wolf, Pa., December 21, 1921. The outer shells of the safe were blown open, but the burglars could not get inside the inner strongbox in the time at their disposal. *Center:* A store job in Wisconsin a year earlier, in which the oxy-acetylene torch was used. *Right:* What the cracksmen left behind them in Henry County, Ind., when they found themselves unable to carry away their loot and their equipment. One tank contains acetylene gas, the other oxygen; and a noteworthy feature is the fire-extinguisher which the crooks carried against the possibility of an accident in the use of the flame

Three typical instances of safe-cracking, showing what the premises looked like after the yeggs had gone

knew how to use the soup. About midnight on some night in the spring, fall or winter (bank yeggs did not operate in the summer because the nights were too brief) this leader dropped off a freight train with another member of his crew or alone. He always left the train at the next town or outside the yards and walked into the town to be robbed, where he met the scout or other members of the gang, who were already on the ground or had come by an earlier train. At an hour determined in advance by the scout, the gang slipped into the town, all armed and one man carrying the few tools and the deadly soup. Everyone was dressed to look as little like a robber as possible.

The first work was to lie in wait for the night officer, spring out on him with levelled revolvers and take him captive. After he had been trussed up under guard of one of the crew, the others went to a blacksmith shop and borrowed a sledge and crowbar, with which they opened a convenient window in the bank building.

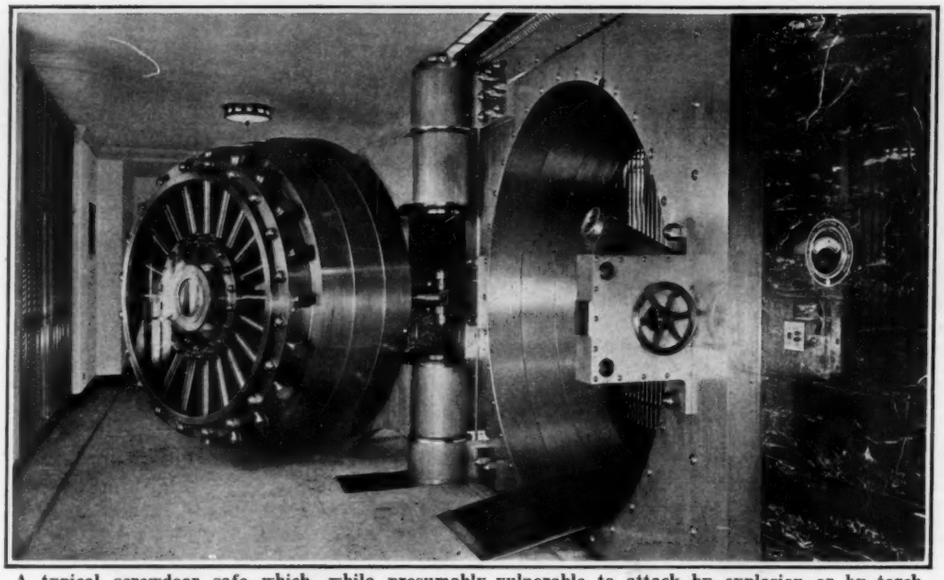
The man guarding the captive officer was now stationed outside the bank as a lookout, while the others worked inside. The cup was rapidly prepared and the first shot of nitro poured in. As soon as it had seeped into the crevice, the cap was set off and there was an explosion which usually tore off or bent back the outer steel sheet of the safe door. This explosion made no very loud report if the yegg who did the blasting was an expert. He knew just how much soup to use and how to confine it so that the detonation was no greater than that of a revolver. Outside any kind of substantial building it could hardly be heard and it was seldom enough to waken a sleeping town, especially in the day when the automobile backfire was coming to be a sound more common than the crowing of cocks.

As soon as the smoke lifted, the soup expert went back to work and fired the next shot on the second casing. Then he fired again and again until he had torn the stout door apart and opened the way to the inner kiester. Usually he had to fire two or three more shots against this stout little receptacle before his job was complete. Then, if luck was with him, the robber chieftain led his men back out of town, pumped a few miles on a handcar, caught a freight train toward the city where his hangout was situated and often was safely home in his hotel before the robbed town awoke and discovered that its policeman had been shackled and its bank burglarized.

The general reader suffers under the same misapprehensions as to the noise of nitro-glycerine explosions that afflict him in respect to safe drilling. He is still back in the old days of the drill and the black powder. As a matter of fact, expert bank yeggs are likely to wake the communities in which they operate about once in five times, and then usually through some miscalculation, a bit of bad scouting or the wakefulness of some sick person or night-walking parent. I have known of numerous cases in which bank burglars of this type fired fifteen to twenty shots of nitro against the doors of the vault, safe and inner strongbox without waking a single sleeper. Nor is this accomplished by wrapping the safe in blankets and carpets, as often assumed. Burglars use such stuffing or muffling when it is handy, but not in the case of bank safes. The art of comparative silence rests upon the skillful handling of the soup and upon nothing else except picking out a substantial bank building that will more or less confine any sound.

With Soup and Torch

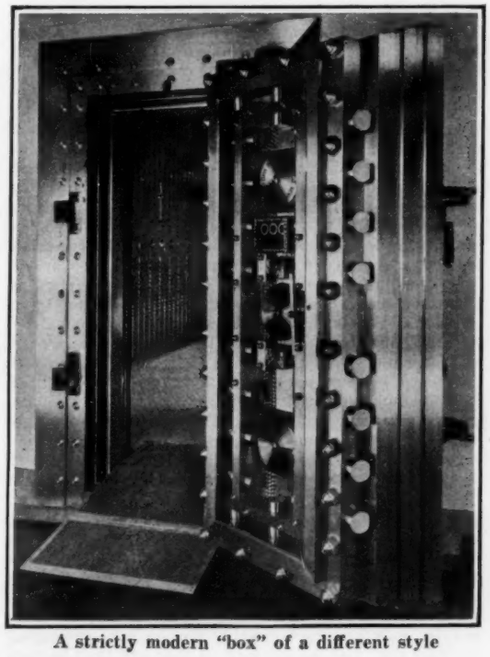
The time it takes to open a bank safe of good make is a point of interest. I believe it safe to say that the average number of explosions required to open the bank safes such as were used in smaller communities ten years ago is about twelve. By the time the yegg technician affixes his cup, lets the soup seep in, pulls and pries away one loose casing and prepares for the next shot, he will have expended fifteen minutes on each explosion. Perhaps, if luck is with him, he may work faster. Thus no burglar can expect to open such a safe in less than two to three hours. The yegg chiefs figured accordingly. When they had a first-class bank job to do they tried to get to work before midnight if possible, so that they could get out of town and away before 3 o'clock, leaving themselves a few hours of darkness for the first stages of their flight and a few hours more before the robbery was likely to be discovered and the alarm telegraphed and telephoned broadcast. In the summer, when there is a waxing light between 4 and 5 o'clock, the bank yeggs ceased their operations altogether, as I have said. Such blowing as was done in this season was usually confined to post office safes and small fry of that sort.



A typical screwdoor safe which, while presumably vulnerable to attack by explosion or by torch, would resist such treatment for more time than the cracksman has at his disposal, and hence is, for the present, immune from violence

About fifteen years ago, when nitro-glycerine was already giving officers, bankers and safe-makers more than they wanted to deal with, reports began to come in of the burning open of safes by means of the oxy-acetylene torch. There had been a bruit of this thing for some time before and the safe-makers had been at work upon safes which might resist the fiery tongue of this new technical implement. Many and contradictory claims were made and the writer even conducted some experiments on safes, with the aid of yeggs whom he happened to know through crime reporting. The safe-makers, after issuing various manifestos, remained discreetly absent.

For a number of years the success of the acetylene torch against modern safes seemed to be in doubt, but this was not due in any way to the successful measures of safe manufacturers but to the fact that an effective torch and its tanks of oxygen and acetylene gas form a heavy and unwieldy contrivance, not easily carried about without attracting attention. This fault limited the use of this new technical device of the robbers and still limits it to some extent, though the burglars have managed to reduce the size and weight of their outfits greatly. However, the torch has been applied to safes with disconcerting success in all parts of the country. The police blotters and reports of the bankers' associations will demonstrate this beyond dispute.



A strictly modern "box" of a different style

When events showed the manufacturers that the torch would bite through any of the safes in existence, they set themselves to the task of making a new box which would resist heat sufficiently to foil the robbers. The fundamental mistake in this line of experimentation must be apparent to the least technical mind. The steel which goes into the making of a safe must be fused, cast and forged, no matter what special ingredients it may contain to contribute to its high fusion point. It is certainly no feat of logic to reason that whatever may be fused once may be fused again and it is, of course, a fact that the welding torch develops temperatures quite high enough to melt any steel known. Nevertheless, a series of so-called manganese steel safes was issued and sold to many bankers under the claim that they could not be melted with the oxy-acetylene torch or that, owing to their special structure, they could not be melted without destroying the contents, in which case the burglars would leave them alone.

But these manganese steel safes, which were of heavy patterns and very expensive, elicited the unpleasant attentions of the gas yeggs as soon as they were installed, and the results were not encouraging. Without going into details, the reader's attention is called to the single typical instance of the reinforced manganese steel safe of the First National Bank of Orange Cove, California, which was burned open by gas yeggs on the night of December 7, 1921, after similar safes and vaults of other California banks had been robbed in the same way. This safe did not resist the acetylene flame, as I have photographs to show. Neither was the money destroyed. The robbers poured water on the parts of the safe not under the flame and, as soon as the smallest hole was cut, they flooded the interior, so that they had a water-cooled box on which to work. The whole operation consumed about forty-five minutes, if the estimates of the officers are reliable.

The safe which cannot be melted with the torch is as much a chimera as were those early safes with special packing that was to foil the old powder man's drill. The solution of the safe-maker's problem does not lie in high-fusion-point metal. What the acetylene flame will not do the electric welding-torch certainly will accomplish, and burglars may find ways of employing it sooner than is pleasant to contemplate.

While it is true that the acetylene torch will melt away any metal practicable for safes it is also a fact that the best and latest kinds of safe and vault doors are so heavy and so well constructed that the torch man cannot enter them in the time allowed him for a burglary, *i. e.*, between Saturday night and Monday morning. Experiments made on behalf of the Federal Reserve Bank at Washington showed that a metal called infusite, a special cast iron alloyed with copper, resisted the torch seven times as long as ordinary steel, and vault doors made of this substance have been employed by the Government. The makers, however, do not claim that the torch will not melt infusite. They simply put their faith, as do the makers of the screwdoor safe, in big, heavy, expensive equipment, too ponderous for the cracksman or torchman to manage in the time nature gives him. The introduction of such doors for vaults is especially important to the renters of safe-deposit boxes, for reasons which appear elsewhere in this article.

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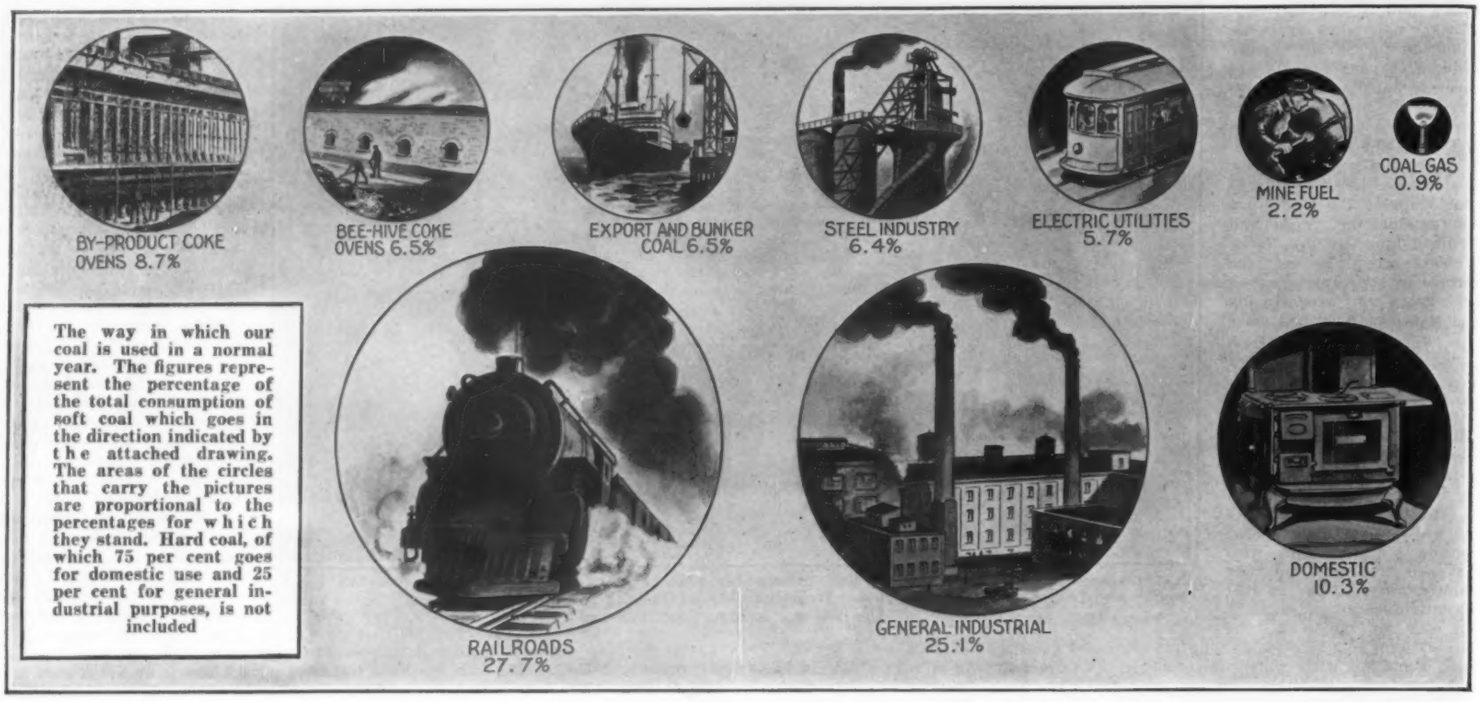


The way in which our coal is used in a normal year. The figures represent the percentage of the total consumption of soft coal which goes in the direction indicated by the attached drawing. The areas of the circles that carry the pictures are proportional to the percentages for which they stand. Hard coal, of which 75 per cent goes for domestic use and 25 per cent for general industrial purposes, is not included

To Keep the Home Fires Burning

Expert Opinion on the Coal Shortage of the Coming Winter and How the Householder May Meet It

Compiled by J. Malcolm Bird

THE miners are back at work, producing coal at abnormal, normal or subnormal rates, according to the condition of the individual mines. But you haven't got your winter's coal in, and your dealer can't tell you a thing except that he will do his best for you, and that he doesn't know what the price will be. As a matter of fact, present indications are that the price for the coal you get (through legitimate channels, of course) will be little if any higher than last year. The trick is going to be, to get coal at this, or any other, price. What are you going to do about it?

One thing you *can* do about it, if you want to. You can do your little bit toward putting the coal industry on a boot-legging basis. You can rush about in panic from dealer to dealer and from "broker" to broker, crying to high heaven that you are freezing to death and eating cold food; that the health of your family is menaced; that you must and will have coal; that you don't care where it comes from or what the price is. If you do all this, you may succeed in getting coal—enough, perhaps, to meet your ideas of what you need. But Providence only knows what kind of coal it will be, or what you will pay for it, or just how much longer it will take the coal market to come back on an even keel again because of your activities and those of others like you.

Bituminous coal is mined, more or less, all over the country. A year's total runs from 400 million tons in a year of bad business to 525 million in a year of hysterical prosperity. Good, bad and indifferent, it is produced under all imaginable conditions. Its mining is far from completely unionized; considerable volumes of it have been dug throughout the recent summer.

It is to the mining of bituminous that our article of October particularly applies. It is plain from that article that, on a basis of normal production and consumption, this industry is grossly overmanned and overdeveloped. We have hundreds too many soft-coal mines and thousands too many soft-coal miners. During the coming winter this will be our salvation—if we are to be saved. So far as the mines are concerned, we can produce coal to take care of any conceivable demand. But there is one fly in the ointment. It is a pretty big fly—a regular elephant, in fact.

Even in normal times, mine output is largely determined by the coal-carrying capacity of the railroads. But the roads are just emerging from a strike which leaves their rolling stock in pretty sad condition. Just how sad is a matter on which no two authorities agree. But we have the very significant facts that numerous roads plan for the immediate future a 24-hour day in their shops; and that the major coal-carriers are already embargoing pretty much everything else save first-class passenger traffic. There seems no escape from the conclusion that during the coming winter we shall have just as much soft coal as the railroads are able to transport.

The case of anthracite is different. It is mined in an area of about 500 square miles in northeastern Pennsylvania—nowhere else. There is no question about the ability of the railroads here, and their connecting lines, to distribute the full production of the mines. But the anthracite mines are unionized "to the last suspender button." Further, in view of the peculiar hazards of this industry, a Pennsylvania law forbids the digging of hard coal save by a licensed miner; and a man must have worked for several years in the anthracite mines, in subordinate capacities, before he is eligible for examination for this license. In any event, the mines themselves, operated for years to full capacity, constitute a physical barrier to the inflation of output. Anthracite mining does not wait for cars or wait on its market. We produce each year some 90 million tons, and each year we burn up 90 million tons. Working full time, the year around, the anthracite miner gets a little ahead of the consumer during the summer, and falls back even with him over the winter. He has just emerged from a total shut-down of five months; and the door is slammed upon emergency manning of the mines or other means for emergency production.

Of the anthracite produced about three-quarters is burned in the kitchens and cellars of New England and the Middle States. The other quarter goes to industries that use hard coal by necessity or by preference. Of the bituminous output our diagram shows that 10 per cent is burned in homes west of Pittsburgh and south of Washington, while the remaining 90 per cent goes for various industrial purposes. The percentages represented by the big and little circles and the pretty pictures therein remain substantially constant, whatever the total production; prosperity and depression hit all lines of industry about the same.

The commercial user is going to feel the pinch—that is inevitable. Indeed, if Federal and State priority enforcement, based on the obvious fact that if a man freezes to death tonight he can't go to work in the morning, turns out to be as stringent as the facts warrant, a materially larger proportion of the coal than usually goes into the household bins may be preempted for such use; and the commercial user will then be even worse off than his present calculations would anticipate. But the commercial user is better able to shift for himself than Mr. Plain Ordinary Citizen. At the worst he can shut up shop like Mr. Ford, thereby relieving the pressure on the market to a definitely measurable extent; while the domestic user is obliged to eat and to maintain a temperature that will keep the water pipes from freezing. On the other hand, the commercial user has at his command the engineering talent and the capital to deal with the problem as it should be dealt with. He can get the best advice on what to burn and how, he can keep in close touch with the fuel markets, he can tap directly sources of supply, he can be assured as the domestic consumer never can that any measure he adopts is an intelligent one and not the prompting of panic. He is far better able to install a relatively expensive plant for burning a substitute fuel and to get the attention of the person who is selling such plants. So with the troubles of the business man over coal, real as they may be, we shall not concern ourselves. This article is addressed to the householder.

The first word of warning is simple. Don't try to buy the winter's coal all at once; don't expect to get it that way; don't be panic-stricken when you discover that you can't.

Allowing for the doubling up of many families over a single apartment house furnace, for the numerous rural homes where only wood is burned, for the use of natural gas and water-given electricity in favored localities, and for the many families that never have more than a dollar at a time to spend for coal, there are perhaps five million individual buyers of domestic coal, hard and soft, who habitually put in a full winter's supply during the summer. At the present moment these five million households are substantially without coal. If they were all to go into the market today, offering fifty or a hundred dollars per ton, or any other figure that fancy dictates, only a fraction of them could be supplied. Their coal hasn't been mined—as Artemus Ward would put it if he were here, "it ain't."

However, it will be. Until it is, we obviously can't buy it. This means that we shall have to get our coal for the coming winter in driblets. We shall have to get used to the hand-to-mouth purchase of coal, and reconcile ourselves to the sight of the cellar floor leering at us through the fast-dwindling pile of black diamonds. Don't expect your dealer to anticipate the exhaustion of your supply; the best he will be able to do will be to meet it. If he has one carload to see him through the week, it isn't going to make him feel any better to have you talk about the immediate delivery of ten tons.

You are not his only customer; if he can't give you a ton, take a half-ton or a barrelful and be grateful. You will probably find that he is a regular human being, interested in doing what he can to keep you going—there really isn't any money for him in your freezing to death. And don't try to play off half a dozen dealers against each other, and by getting a little from each to accumulate a winter's supply. Your regular dealer has a certain obligation to do what he can do for you, and he is the only one who has. If you start patronizing the boot-leggers, that obligation is dissolved, and he will be quite justified in telling you to get the next where you got the last. Then the boot-leggers have got you, and got you good.

The nearer you are to the mines, the better the prospect that your dealer will at no time have to leave you with absolutely no coal. But in many parts of the country the coal supply will undoubtedly fail from time to time. First and last and for the country as a whole, it is suggested that there ought to be available something like half the normal supply of domestic fuel. Some of us will get more than this, others less. What are we going to do about it?

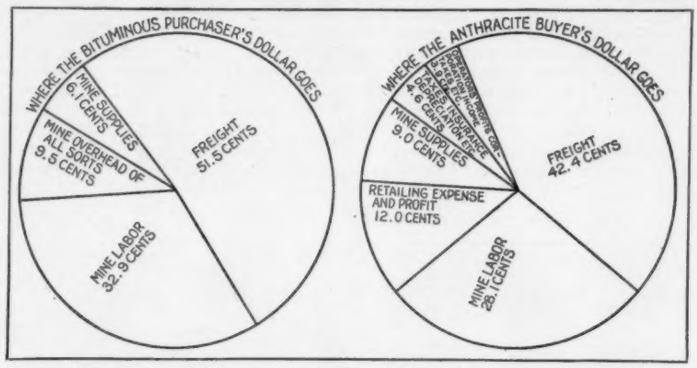
One thing is obvious. If December were here, and you had exactly half your usual supply of coal, and knew for an absolute fact that you shouldn't be able to get any more—you would stretch it over into March, wouldn't you? You would bank the fire at times when you were in the habit of letting it burn; you would take particular care to have a clean fire-bed at all times so that no fuel would be partially consumed; you would watch the draft as a cat watches a mouse; you would let the kitchen fire die every night, and use plenty of wood in getting it up again in the morning; you would use every trick in the bag, and pick up new tricks from all the neighbors. Do these things anyhow; and we have a very definite idea that, when you ask your dealer for coal, you will get it faster than the man around the corner who burns twice as much for a family of the same size. If you don't know how to nurse a fire, learn how; you will need to know before the winter is behind you.

After the above was written and before it went to the printer, announcement was made by the New York State Fuel Controller that household users would be restricted to the purchase of two weeks' supply at a time. They will be required to show that what they ask for *is* a reasonable two-weeks' supply, and to certify that they have bought no coal during the preceding two weeks. Such regulations will doubtless be in force in numerous states and municipalities. Their violation in New York, by buyer or seller, is to be punishable by fine or imprisonment, or both. The bearing upon the three paragraphs immediately above is evident.

With the many complications of production and distribution, there will be numerous times and places where coal of the accustomed variety cannot be got, but coal or near-coal of some other sort is available. Buy it, burn it as well as you can, and learn to burn it better. This winter, coal is coal.

In particular, the man accustomed to hard coal will often have to use soft. It ought to have a different grate, but when burned in emergency in a hard-coal furnace this is not practicable. It needs more attention of every sort—more stirring and poking, more raking, more nursing of the draft. Your dealer, or the Bureau of Mines in Washington, will instruct you in the details. A few of them, moreover, will be found on page 309, together with a discussion of other solid fuels which may be substituted for coal, by a more or less complete revision of the heating arrangements of the house.

In this discussion will be found the statement that the household furnace often turns out an ash of which 20 per cent is combustible. It sounds as though this ought to be susceptible of recovery. We believe that, at least by the individual householder, it is not. It has always hurt our own feelings to see unburned and half-burned coal going on our driveway, so we undertook its salvage. But we took the trouble to keep track of the time thus spent and to weigh the coal obtained. Quite aside from the disagreeable character of the work, the capital invested in the sifter, and the fact that a pound of alleged coal that has been through a furnace fire is not a full pound of coal-fuel value but has necessarily been partially burned; we found that at current quotations of some $12 per ton for coal, sifting ashes and raking over the remains was paying us the handsome wage of six cents per hour. We decided that this was no wage for a gentleman and a scholar (we hope we flatter ourselves on neither count); and from that day we have not sifted an ash, nor raked over a cinder in search of semi-combustible material.



Where the consumer's dollar goes. The freight charges are for a haul of average length

Solid fuel as a substitute for coal is all right; but doubtless more people will turn to kerosene or fuel oil during the coming winter than to any other single expedient. The price will go up—way up, perhaps, in response to this stimulus. In mid-September, kerosene delivered to the writer by tank wagon had already scored a half-cent rise. If one is really without other fuel, however, that is a detail; and the average user will pay excess profits to the oil man, in the present emergency, with better grace than to the coal man.

We need not go into details with regard to the use of kerosene or fuel oil for heating or cooking; for such use requires a special burner, and the manufacturer will supply full instructions. It may, however, be in order to indicate some of the possibilities to those whose knowledge of oil-burning comes solely from the messy, smelly kerosene lamps of the old-fashioned farmhouse.

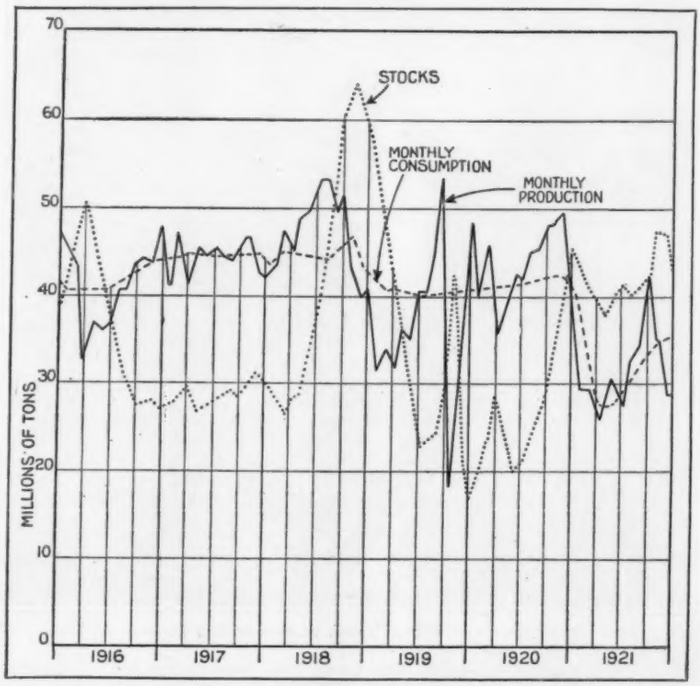
Kerosene is best burned in the wickless, blue-flame stove. This operates more or less like the carbureter, vaporizing the oil and burning it as a gas, mixed with air. Starting from cold is easier, however; a wick is present, and is lighted, burning in the familiar fashion until there is heat enough to make gas. At normal prices cooking in this way is cheaper, quicker, cleaner, and more readily controlled than by coal.

Particularly useful is the blue-flame water-heater which can be attached to the water-back of the ordinary coal range. Both coal stove and oil burner and all their connections remain in place permanently; the use of either does not demand that the other be in any way dismantled or disconnected. With two burners, the oil heater gives a rousing boilerful of hot water in three hours or less.

Many of the makers of kerosene and fuel-oil apparatus put out burners especially designed for heating the entire household in the place of the conventional coal furnace. If you contemplate the installation of any of these oil-burning devices, however, do it today; if you wait until the winter has begun to make a real impression upon our collective nerves, you may find oil stoves scarcer than high-grade anthracite of stove and egg sizes! Your hardware merchant can give you names and addresses—and if he is on the job, catalogs *ad lib.*

The expense of putting the entire house on an oil-burning basis may be rather higher than you had imagined. But if you once put in such a system, you may regard it as a permanent investment. In one of New York's largest office buildings, operation with fuel oil effected a 34 per cent economy which paid for the entire installation in 21 months.

For heating single rooms, especially over short periods, nothing can beat the small, wick-burning oil stove of the modern, circular-flame type. You come in with your wraps on, light the stove, and by the time you get out of your furs and into your lounging clothes the temperature of the room permits lounging. Then the flame is extinguished, and the consumption of fuel stopped, the instant you are through with the necessity for a fire. For business folk who come home to cold rooms; for heating bedrooms, dressing-rooms, bathrooms and even dining-rooms against immediate use—for piecing out all over the house, in fact, one or two of these stoves are an invaluable part of the householder's emergency equipment. When the family arrangements are such that only one or two rooms are ever in use at a time, a small oil stove may be shifted from room to room as wanted and will almost take the place of a furnace. Gas stoves of similar construction constitute a similar convenience and economy. In fact, by those who live along the gas mains, "gas" may be substituted for "oil" throughout the above discussion.



A graphic statement of the seasonal characteristics of the soft-coal industry. The drop in production in 1919 represents a strike; that in 1921, a business depression with reduction of demand, as is made clear by the corresponding sag in the consumption curve

There are fuel resources of various character which are not yet developed, and which many hopeful souls will try to utilize during the emergency. As good an example as any is peat. Our regular readers will recall a recent article by a Federal Government engineer in which the extent and the potential fuel value of our peat resources is made evident. Emergencies like the present stimulate greatly the efforts to find a way of profitable utilization for such resources; but little immediate aid in the emergency should be expected. We must develop the peat industry before it will be available for our relief, and this we cannot do during one winter. The same may be said of any other fuel resource as undeveloped as this one.

The good old-fashioned wood stove is by no means to be ignored in the crisis. One does not have to have a wood-lot in one's backyard to get wood to burn; and in many districts this will be as cheap as any fuel obtainable. Those who have learned to cook with it know that its quick, hot fire gives better service for many purposes than any other solid fuel. Unskilfully handled, a wood fire burns up fuel faster than two men and a boy can cut it; but any fire is extravagant when poorly managed. The use of wood in big open fireplaces should be avoided where possible, however; such a fire is mightily pleasing to the eye, but it represents the last word in extravagant use of fuel.

A Cable-Way Among the Clouds

How Passengers Are to be Carried Up Mont Blanc in a Suspended Cage

By Frederick Harrison Burlingham

THINK of swooping through the air, from Alpine crag to crag, on a real scenic railway over two miles high! This queerest of engineering projects, stranger than anything that has been attempted before, not only has proven feasible but part of the line is now in operation. It was under construction when the war broke out, but the suspended work has recommenced and, according to press dispatches, the line soon will be open to tourists.

This unique railway, technically known as a teleferique, will run from Les Bossons, in the Chamonix Valley, France, up the Aiguille du Midi, 12,608 feet high, one of the jagged, precipitous needles in the Mont Blanc range. Tourists, in ninety minutes, will be transported from summer heat to the arctic zone of Mont Blanc, swooping safely through the air while avalanches of snow and ice crash harmlessly by, hundreds of feet beneath the suspended cars.

The idea behind this novel engineering feat is to transport tourists skyward to the land of eternal snow and ice. Hundreds of thousands of tourists have seen Mont Blanc from below, but by means of this teleferique line many will be transported safely and comfortably to a spot where only the hardiest of alpinists have ever ventured, and where visitors wishing to escape the heat of summer may indulge in all kinds of winter sports.

During the early construction period, when I ascended this teleferique with some Swiss engineers, I was fairly staggered by the daring of the project. As a mountain climber I know that the Aiguille du Midi, from the precipitous Chamonix side, is a climb only for experts. It has a bad reputation for avalanches and falling stones which in some couloirs come down every few minutes. I myself have been in a bombardment of singing stones falling from great heights whose tremendous speed rendered them invisible. The preliminary work has therefore proven extremely hazardous, requiring expert mountaineers; and already a number of workmen have been killed by avalanches.

"It is true," said the director, "that the work is dangerous, but as soon as we get our cables anchored on certain peaks much of the difficulty is overcome; for then there will be no more climbing and all material will be handled by temporary cables. The engineering difficulty is properly anchoring the cables. Once these are in position there will be no work on the treacherous glaciers beneath, and as avalanches do not fall from the sky but follow well-defined gullies they will descend harmlessly below us. By sticking to the peaks we are out of harm's way, for the paths of destruction lie between."

The lower part of the teleferique has been operating for some time. From the lower terminal station at Les Bossons to the electric power station at Pierre Pointue, 5478 feet high, one ascends over 6500 feet of cables suspended on twenty-seven pylons separated by distances varying from 82 to 475 feet. To reach the power station above, passengers ride in suspended cars with a seating capacity of twenty persons. This power station at Pierre Pointue is on the alpinist's route up Mont Blanc and from the terrace one has a superb view of the valley of Chamonix below, while alongside is the vast glacier des Bossons and beyond the Aiguille and Dôme du Goûter, of Mont Blanc. With telescopes one may see the cabane of the Grands Mulets or refuge surrounded by ice where climbers sleep at night before attempting Mont Blanc.

From the power station at Pierre Pointue to the third station at the base of the Aiguille du Midi there is a second series of twenty-four pylons and the cable between these two stations is 4592 feet in length.

The view from this height is superb. Chamonix is nearly one mile below—4600 feet to be exact—and from here one gets an idea of the majesty of the Chamonix aiguilles, or needles, such as the Aiguille du Plan, the Blaitière and the Charmoz. One has a bird's-eye view of the whole Chamonix Valley from the Col de Balme to Servoz with the Aiguilles Rouges on the other side of the depression. Mont Blanc appears more magnificent from Chamonix, but from here the immensity of the ice-fields and tottering ice-crystals creates a tremendous impression.

This station is a rest station. The ascent to here is so rapid and the change in the density of the air so great that tourists must stop to get acclimated. Starting upward again, one swoops aloft through the air. The system of transportation changes and the ride becomes sensational in the extreme. The cars used on this aerial section are smaller, more like a basket, and accommodate only sixteen persons. When the signal is given the car immediately runs out on a single span of unsupported cable 2130 feet long, swaying 500 feet above the Glacier Rond. The feat, in this case, has been to anchor the long cable, for at the lower end the engineers have been hampered with loose moraines and have had to descend considerably into the earth to get a solid grip.

The fourth station, altitude 9381 feet, is situated on a pinnacle of granite almost opposite the Grands Mulets, and passengers reaching here will begin to comprehend what real alpining is, for such points are still attained by actual climbing. This station, however, is little more than a relay for the objective is the Col du Midi, 11,647 feet above the sea. To swing from the fourth station to the summit of the col is impossible in one swoop, so halfway, on a projecting pinnacle, the engineers are going to place a tension pylon to relieve the strain. To this tension pylon, however, is an unbroken swoop of one-half mile—2788 feet to be exact—and from the tension pylon to the summit another shoot of 1837 feet. The inclination of the teleferique varies from 15 to 48 degrees.

At the top a hotel is to be erected, to accommodate about thirty persons, for those who may wish to spend the night aloft. To the south nearby is the Vallée Blanche, a vast snow field which feeds the great Glacier du Géant, which in turn, miles further on, forms the world-famous Mer-de-Glace. According to the promoters, it is thought winter sports in August may prove popular here. Tourists from the hotel at the Col du Midi easily could climb the remaining 1000 feet of the Aiguille du Midi with the assistance of good guides. Experienced alpinists could use this station as a base for climbing the Dent du Géant, one of the most famous rock climbs in the entire Alps. By crossing the Vallée Blanche to the south strenuous tourists with guides could easily reach the Rifugio Torino on the Italian side of Mont Blanc range. Contrary to press reports, this aerial line will not assist in the climbing of Mont Blanc proper. An attempt to climb Mont Blanc from the upper terminus would mean traversing the Mont Blanc du Tacul, as well as the Mont Maudit, both of which are more difficult than Mont Blanc proper and more dangerous.

Ingenuity has not been spared to make this freak railroad absolutely safe. During the first part of the voyage the cars will run on double cables 64 millimeters in diameter, so that in case one breaks the other will be sufficient to stand the strain. Should the traction cable break, the cars will stop automatically by gripping a second cable used for braking purposes. In this case, by simply turning a switch at the power house, the brake cable can be run over the revolving drums, thus acting as the traction cable. Engineers claim this new system will prove cheaper than all others, for there will be no maintenance of way except the daily inspection of the pylons and the cables.

Riding on the teleferique is an entirely new sensation. From personal experience I can testify there is merely a slight side swinging, the motion being as smooth as that of a boat on a placid lake. As we rolled toward the first pylon the car moved more slowly and the traction cable tightened until the pylon was reached. Then click! click! and we swooped down rapidly until the traction cable took up its slack. Up and down, twenty-seven times, gradually climbing higher until we arrived at the power station as gently as a gondola touching its wharf.

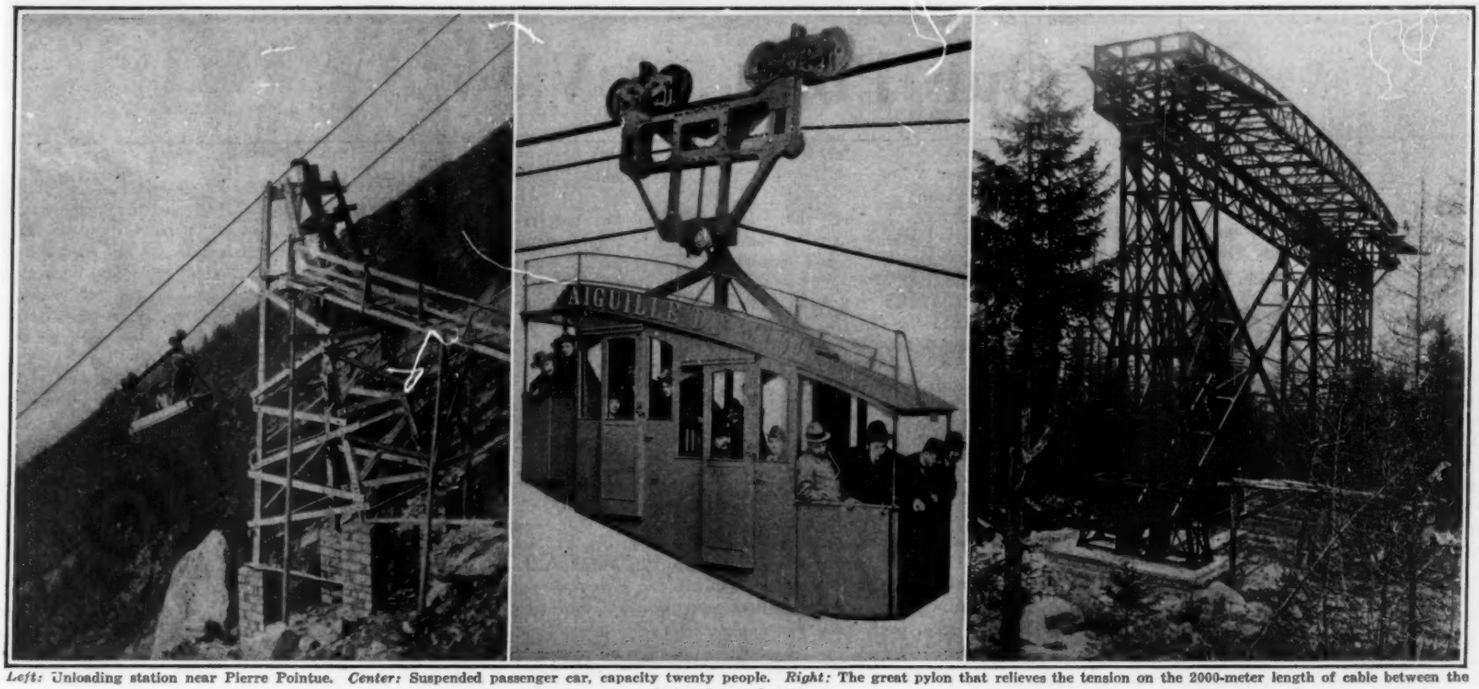
On the higher reaches there will be new thrills. As one swoops toward the dizzy crags the earth below will seem to fall away. At an intense moment some tourist in the flying car may be attacked by vertigo, but his complaints suddenly may be drowned by the booming, thunderous roar of an avalanche passing directly underneath!

This, then, is something new in scenic railways! The traveller who is in search of new sensations may get his fill of them here.

Mont Blanc, the "Fool-Killer," with village of Les Bossons at foot

Wood-Wasps Which Gnaw Through Leaden Plates

EVERYBODY knows that the larvae of many insects do great damage to furniture and such like by gnawing the timber. Still more serious damage may be done to roof-beams by ordinary wood-eaters. Most



Left: Unloading station near Pierre Pointue. *Center:* Suspended passenger car, capacity twenty people. *Right:* The great pylon that relieves the tension on the 2000-meter length of cable between the first and second stations

Three details of the "teleferique" or cable-way up Mont Blanc

astonishing, however, are the deeds of the pine or giant wood-wasp (Sirex gigas L) and of the pine-worm (Paururus juvencus L). The females of these insects, whose time of flight is mainly in July and August, lay their eggs in sickly or newly felled stems of pines, firs, and larches. Inside of them the larvae dig their passages, which takes about two to four years, and then they turn into pupae. When slipping out the insects always choose the shortest passage going outward, and do not deviate from this direction once they get accustomed to it, even if the wood in the meantime has been worked upon and a leaden plate is barring the way. Even through the lead they force their passage, and they need but 48 hours to gnaw through a leaden plate of 4 millimeters in thickness. How stubborn and inflexible these insects follow their passage has often been seen in cases where the passage ended just on the border of a leaden lash and they had to bore partly through the lead, partly through wood. By deviating from their usual course merely a few millimeters they might have avoided gnawing through the hard lead.

In literature several incidents of this kind have been reported, and they happened generally in lead chambers of factories making sulfuric acid. So great a damage the wasps had committed in these instances that *at times the working of the factory was threatened*, because every hole they bored would allow the sulfuric acid to flow out and get lost.

In one case, however, most extensive damage was done, according to a report of Mr. O. Harnisch, to a sulfuric acid factory in southern Silesia which had been built in the beginning of 1921. In the summer months already the lead chambers began to leak, and on thoroughly examining the building it was found that almost all wooden parts were damaged by wasps, while only the leaden plates showed boring holes, 100 in number. The factory had to stop working, but to wait until all wasps might have finished flying out would have been impossible, for the first flight having taken place last summer, it could be taken as a certain fact that the eggs had been laid two years ago, in 1919, and therefore the last wasp might not fly out before the further lapse of two years, *i. e.*, in 1923. A combat of the pernicious insects in the usual way by applying heat, hydrocyanic acid, by painting all parts with carbolineum, creosote, tar, etc., was partly unfeasible, partly useless, for it would have been impossible to reach and kill the insects inside of the wood. Thus there remained nothing to be done but to put a coat of some viscid material (perhaps a mixture of creosote and tar) between the wood and lead, which would make it impossible for the insects to gnaw through, or to use sheet-iron for this purpose. The latter way was chosen, but it was very expensive, and besides there had been a heavy loss of output.

To avoid damage of this kind great care ought to be taken in building such factories to use only thoroughly sound and healthy wood, *i.e.*, wood of trees that have been felled during winter time and removed from the spot before the time of flight of the wasps. In the sawmills the wood ought to be protected by giving it a coat of creosote, carbolineum or some such like.

Keeping Irrigation Ditches Clear

SUCCESSFUL adaptation of modern machinery to the important tasks of removing silt and sand is now to be seen in the Imperial Valley, once the sunken desert of California and now her sunken garden. The Colorado River, which is often spoken of as America's Nile, is one of the dirtiest streams in our country. It carries an enormous load of fine silt in solution, which is deposited in the irrigation canals. Removal of this sedimentary deposit is expensive and laborious.

A dozen years ago there came to this valley a blacksmith of mechanical and observing mind. He mended the machinery of the farmers who dwelt all about him and noted the difficulties which beset them in their fight with unfriendly nature. Ditch cleaning with horses and fresnos impressed him as slow and inefficient. He set his mind to the task of turning out a machine to render easier this labor of his neighbors, and after several years of trials and experimentation success crowned his efforts.

The ditch cleaner operates the reverse of most machines used for digging, as it excavates from the side and not from the front. It consists of a framework of I-beams in shape like a right-angled triangle, approximately thirty feet long. It is supported on three wheels, the front wheel at the apex of the triangle being utilized for steering. At the rear are two wheels, geared to the same angle, one of which is for propelling, and the other resting on the opposite bank supports the machine. Power is obtained by a 2-cylinder, 2-cycle, 15-horsepower gasoline engine. Two methods of locomotion are used. On the dredgers for small ditches the machine is moved by means of a long cable operating from a take-up drum with a loose end of the cable attached to a movable stake on the ditch bank. On larger machines the standard caterpillar tractor with increased power is used. The dredging is done by a line of buckets attached to an endless chain, which operates transversely across the ditch. The machine has been demonstrated to be entirely practical, and the cost of cleaning by this method is only half of that where horses and fresnos are used.

For some time it was not thought that this dredger could be used in the larger canals owing to distance between banks. Last summer another engineer in Salt River Valley, Arizona, hit upon the plan of setting the wheel at the end of a long axle on a barge floating in the canal. It worked successfully and proved of great benefit because it enabled cleaning to go on without interruption of irrigation. The dredger moves up one side, cleaning half the canal, and returning on the other side completes the job.

In addition to effecting a decided saving in cost and greater rapidity in completion, the machine does better work than the fresnos by leaving a smoother and more uniform surface on the sides and bottom of the canals. With the coming of cheap electricity in many of our desert valleys it is entirely probable that many of these machines will be operated by this force in the future. A wide field of usefulness is open to this machine in our swamp-land States, where the maintenance of clean drainage ditches is still a vexing problem.

When the ditch is too wide to permit this dredging machine to ride with its supporting wheel on the far bank, as its designer planned, a barge floating on the surface of the water solves the problem

Our Point of View

Needless Airplane Accidents

THE RECENT tragic fate at a fair at Rutland, of Lieutenant Maynard, Lieutenant Wood, and their mechanic, who fell to their death from a great height, constrains us again to urge upon Congress the passing of legislation for the regulation of aeronautics. Lieutenant Maynard, as we all know, was a flyer of consummate skill, who attracted the attention of the world by winning the Army trans-continental contest. He did good service in the great war, and should surely be reckoned as a flyer of the highest competence. It has been rumored that he fell in the voluntary performance of what is known as the "tail spin," out of which, we are told, the pilot failed to bring his machine.

It is possible, nay probable, that in the case of Maynard something went wrong either with the engine or the plane; but the fact remains that he was giving a typical fair-ground exhibition, and probably was taking those chances with death which even in this highly civilized age seem to form no small part of the attraction in these dangerous performances. Any reader of the daily press will realize how largely daredevil feats in the air are responsible for airplane fatalities. Unfortunately, the victims have included many of the thoroughly trained ex-officers of the service. Hence, it is necessary, for the protection of the public, that Congress listen to the appeal of the aeronautical societies, of the manufacturers, and of all the thinking public, and make haste to consider how best by regulation it can prevent this loss of life.

It cannot be denied that the frequency of airplane accidents has had a depressing effect upon the development of commercial aviation. We do not doubt that there are thousands of people who would have used the commercial airplane for quick travel had they not been intimidated by the frequent disasters. It was not until the public realized that the automobile was reliable and could be controlled by any intelligent person, that the motor car began to make rapid headway. It would prove to be the same with commercial aviation. There are machines on the market today that are perfectly reliable, and there are plenty of pilots who do not take, and have no wish to take unnecessary risks, and there is no good mechanical or economical reason why commercial airplane travel should not now come fully into its own.

What we need is a law with clauses calling for the periodical inspection of machines, and for the rigid licensing of pilots. Today, anyone who has the money can buy an airplane, fly it, and invite people to go up with him at so many dollars per head; and to this situation many of the accidents must be charged. If no one can drive a motor car without a State license, why in the name of common sense should it be possible for Tom, Dick, and Harry, to engage in the far more difficult practice of aviation, without the slightest governmental control? What such control can accomplish is shown by the superb work of the air mail service, which this year has flown 2,000,000 miles without a fatality and during the two months ended September 9 maintained an efficiency of 100 per cent.

Honoring a Notable Inventor

IT IS not often that it can be said of an invention that "it was a basic invention, conceived, tested, put in practical operation in many installations, and perfected as a system in all its details by its original inventor." Yet this is the tribute which is paid to William Robinson, an American inventor, in a pamphlet which has recently been issued by the Signal Section of the American Railway Association. Because of his development of an automatic signal system in 1867; of his installing of the so-called "open-circuit" system on the Philadelphia and Erie Railroad in 1870; and of his basic and epoch-making invention of the closed-track circuit in August, 1872, Dr. William Robinson is certainly entitled to be called the father of automatic block signaling.

It was in 1867 that this inventor, who had recently graduated from college, set about developing an automatic signal system for preventing railroad accidents. Within three years he had developed what is known as the "wire" or "open circuit" system, in which there were circuit-instruments adjoining the track, which were actuated by the wheels of a car. The wheels acted on a lever and closed the circuit through a relay, whose magnet, becoming magnetized, attracted its armature and kept its own circuit closed. When the train reached the proper point ahead, it actuated a reversing lever, opened the relay circuit, and reversed the signal. Robinson made a successful exhibition of this basic device at the American Institute Fair in New York City, in 1870; and at that time a very able and progressive railroad man, Mr. William A. Baldwin, General Superintendent of the Philadelphia and Erie Railroad, decided to install the system on his road. This first installation performed all that was claimed for it, and proved satisfactory to the railroad company.

Thereupon, Mr. Robinson, who was a severe critic of his own work, became aware of the serious defects of his and all open-circuit or wire systems of automatic signal; inasmuch as under certain circumstances they may show a safety signal at a time when the very danger exists which they are designed to avert—notably in the case of a train which, after entering the section and setting the signal at danger beyond it, breaks in two, the forward part passing off the section reversing the signal and showing all clear beyond the after portion of the train, which still remains on that section. The inventor quickly realized that for safety every car and every pair of wheels in the train must have controlling power over the signal throughout every inch of the block section, consequently, that the signal should go to "danger" by gravity, the electric current being used to hold it at "safety." He cast aside the open-rail circuit as fruitless, and designed the closed-rail circuit system substantially as it is used today, and as far back as 1871 applied for a patent thereon, which broadly covered the closed-rail circuit system.

A working model installation of this system was exhibited in 1872 at the State Fair held at Erie, Pa. This outfit included a large gong at the end of one of the buildings, and a track made in sections, placed in a long water tank which covered the track and the running gear of the car model. The system was connected on the short-circuit principle through the rails, and wires connected the gong with the back contact of the track relay. When the car entered the signal section, it short-circuited the current from the relay, and this, releasing its armature, closed the circuit through its back contact, and through the gong circuit, thus setting the gong ringing loud enough to be heard all over the grounds. The cars and the apparatus were not affected by the water, and as the car ran off the section the current returned to the relay, opening the gong circuit at the back contact of the relay, and shutting off the gong.

Mr. Baldwin had the inventor install his system at Kinzua, Pa., where he had placed his first open-circuit wire system, and the conversion into a closed-rail circuit system was soon made. The track joints, however, proved an obstacle, and the next advance was devising a rail bond suitable for continuous service, and in 1872 Mr. Robinson conceived the invention of the bond-wire method of electrically connecting the rails. In a subsequent installation, in addition to the automatic gong, the passing trains were made to operate a visual block signal, so that here within a space of a few years this young American not only blazed the way for automatic train signaling, but put into successful operation on a main railroad a system which functioned satisfactorily, and was theoretically and practically so complete that it has remained in uninterrupted use for over half a century.

Is Our Navy in Jeopardy?

IN WELL-INFORMED circles in Washington it is realized that our Navy is liable to be placed in jeopardy because of the onslaught both of the out-and-out pacifist and of well-meaning people, who do not understand the necessity for maintaining our fleet in absolutely first-class condition, even when there is not a cloud upon the political horizon. We warn the public that, unless they watch these tendencies very closely, and instruct their Congressmen to maintain the Navy at the point of strength designated by the Disarmament Conference, there is very grave danger that our fleets will dwindle as they did after previous wars, in which the United States was engaged. After the war of the Revolution, and after the Civil War, the country, in a feeling of false security, neglected to make the necessary appropriations to maintain the Navy in a state of efficiency. We know only too well that the great World War found us woefully unprepared to meet the enormous responsibilities that were thrust upon us. Today the nation must wake up to the fact that tendencies which may bring about the same conditions are still active in our midst.

In the early part of this year, when Congress in an unreasoning fit of economy was trying to cut down the enlisted strength of our Navy to 67,000 men, we made careful inquiry in the most authoritative quarters, and learned that it would be possible to maintain our fleet only in fair efficiency if the strength of the personnel was 96,000. Even with this force it would be possible to man only one broadside of our ships at a time; the men in the ammunition handling room would have to be reduced below the number necessary for rapid firing; the men in the engineer's department would have to be so reduced that full speed could be maintained for no longer than two watches; target practice would have to be modified by cutting down the number of rounds per minute and the total amount of target practice would have to be reduced; the speed of the battleships lowered from twenty to ten knots; of the destroyers from thirty-five to fifteen knots; the use of the ships at national and holiday celebrations curtailed; and finally the ships would have to be sent less frequently into harbor for re-conditioning. All this lessening of the effectiveness of the fleet would have been necessary even with the 96,000 men asked for by our Navy Department. Congress granted, however, only 86,000 men, and with this force it expected the Navy to keep our fleet in the same state of efficiency as that of the British, although the latter has a personnel of from 105,000 to 115,000 men.

During the next term Congress will be asked to appropriate for a Navy of 96,000 men for the next fiscal year. The argument for this number, which was strong last spring, is doubly so now; first, for the reason that the practical test which has been made through the past summer of a strength of 86,000 has shown conclusively that that number is inadequate; secondly, because there will be an increased demand for men, due to the fact that a considerable number of new ships will be completed and added to the fleet during the year. These additional ships were provided for by the Disarmament Conference, and they include two new battleships, "Colorado" and "West Virginia"; practically all of the ten 7000-ton light cruisers which are nearing completion; over a score of submarines which have been completed and are ready for commissioning; and the two large airplane carriers which were called for by the Conference agreement.

In asking for the 96,000 men the Navy Department has cut its estimates for upkeep and operations for next year to the lowest possible figure, and it is asking the smallest amount possible for new construction. In considering the need for a larger force (not larger than is needed by the Navy, but larger than was granted by Congress) it must be remembered that this year the enlistment periods of 88,000 men will expire, with the result that there will be a great inflow of green

Our Point of View

men into the Navy, whose efficiency cannot, of course, be compared with that of the men whose term is expiring.

Although the Navy has drawn up a comprehensive plan for the development of naval aviation, it is not proposed to ask more than a very moderate appropriation for this work during the next year.

Developing Traffic on the State Barge Canal

TO CONNECT the Great Lakes with New York by a canal having a uniform depth of twelve feet has cost the State about $170,000,000. The greater part of this large sum has been spent in excavation, and in the construction of locks and dams; the rest of it has gone for docks along the route of the canal, and for adequate terminals at each end.

Doubtless, many people who travel through the Mohawk Valley, whether by train or motor, have been struck with the apparent dearth of canal traffic. To expend $170,000,000 on a public work, only to find on its completion that the public is making very limited use of it, is profoundly disappointing; and yet a close study of conditions will show that Barge Canal traffic is greater than it seems, and that there are certain temporary conditions which have militated against the early success of the canal. There is no good reason to doubt that, in time, the canal will prove to be a great economic asset to New York State, and to the vast regions beyond the boundaries of the State, which the canal will directly or indirectly serve.

For several decades after its opening, the old Erie Canal formed the one great route for the transportation of supplies between New York, the Great Lakes, and the intermediate territory; and to this waterway New York State and New York City were indebted for their rapid development in the early part of last century. It continued to be the main route even after the opening of the railroads; but ultimately the greater capacity and speed of rail transportation drew away from the canals an ever increasing amount of its traffic. The first canal was a modest affair, only a few feet in depth, and even when, to meet rail competition, its depth was increased to seven feet, it soon proved to be altogether inadequate. The present 12-foot canal was constructed with the idea of accommodating barges of from 2500 to 3000 tons, thereby securing the benefits which come from the transportation of freight in large units.

Now, the period of years covered by the decline of the old canal, the construction of the new canal, and the distraction of the war, left the railroads in complete possession of the field. Shippers and merchants became accustomed to rail transportation; a new generation sprung up which knew nothing of canals, except by hearsay and tradition. In other words, the people concerned had lost what might be called the "canal habit." It is now the task of the canal authorities, by giving efficient service and by means of wide publicity, to teach the public the advantages of shipment by canal. In doing this they have a strong case to present. In the first place, the canal can transport far more cheaply than the railroads. Thus, on April 30 of last year, when navigation opened, the rate on wheat was 12.1 cents per bushel by rail, whereas the canal charged only 9.7 cents. In June the canal was carrying wheat at 8.5 cents, and in August the rail carriers reduced their charge on wheat to 9.1 cents per bushel, which was met by the canal with a rate of 7.9 cents. Such an inducement should be irresistible if other conditions are equal. Of course, the average transit by rail is faster; but now that the canal is being equipped with self-contained, motor-driven barges of 2500 tons capacity, it is possible to carry freight the whole length of the canal in four or five days, which compares favorably with the average speed by rail. During the season of 1921 the canal carried a total of 1,457,802 tons.

The State has built the canal, just as it has built its system of highways, for the promotion of the welfare of the State. Any bona fide company, or any individual, may build barges and operate them on the canal, and it is encouraging to note that already there are no less than 1223 barges afloat. Although there is an increased amount of general merchandise making use of the canal, its main duty, as in the case of the older canal, must be the transportation of grain; and last month, in opening the very fine two million dollar elevator in South Brooklyn, Governor Miller, in a survey of the present status and future prospects of the canal, expressed the conviction that while the growth of its business, due to causes such as we have mentioned, has been slow at the start, there is no question of its ultimately carrying a large amount of freight which, because of the cheaper rate, will be glad to seek this route.

The Highway Crossing Menace

THINGS have come to such a pass in the matter of accidents at grade crossings as to call for a thorough study of the matter with a view to taking preventive measures. In the early days of the automobile it was the highway traffic which ran the risk and suffered the penalties of collision. The machines were comparatively light, and invariably, in the case of collision, they were tossed aside or crushed beyond recognition. There was every risk for the automobile and practically none for the train. Very rarely indeed did the latter suffer any hurt. The motor car that stalled on a grade crossing, or failed to get clear, was swept aside with practically no perceptible shock to the passengers on the train.

With the increase in size and weight of automobiles, and particularly with the coming of the motor truck, the risk of disaster and death has begun to be shared by motor car and train alike. Tragic evidence of this fact was seen in the recent wreck at Annandale, Minn., of a train on the Soo line, which resulted in the death of ten railroad passengers and the injury of a great many more. The collision, which occurred as a motor truck was passing over a grade crossing, proves that a smashup of this kind may now be as disastrous to the train as to the motor car. Nor does this case stand by itself. During the past three months similar collisions, resulting in injury to train and passengers, took place on the Lehigh Valley, on the Erie, and on the Pennsylvania systems. It is evident that grade crossing accidents may be as disastrous, and indeed more so in respect of the number killed or wounded, to the train than to the car. Furthermore, the seriousness of the situation is aggravated when we remember that highway traffic is increasing by leaps and bounds, and that there is, therefore, a growing number of those fool-hardy people who have no understanding of the risks of motor car travel, and who even when they know the danger are willing to take a chance and risk disaster.

Now that criminal carelessness is beginning to cause the wreck, not merely of the motor car with its limited number of passengers but of the train with its many hundreds, there is surely a call for government action. Obviously, the most effective preventive is the elimination of grade crossings; and though it is impossible to eliminate all of these, the safety of the traveling public, whether on highway or railway, demands that roads with a heavy motor traffic should be carried over the tracks instead of across them at grade.

As an alternative to building costly overhead highway bridges, it might be possible to develop a system of highway signals similar to the semaphores of the block signal system, and place them some distance up the highway from the crossing. The speed of automobile travel has risen considerably in the last few years, and the automatic bell signals, announcing the approach of a train, are too faint to be effective, and appeal only to the sense of hearing, which in many people is very deficient. A system of highway signals operated by the train, placed a sufficient distance from the crossing, and exhibiting a semaphore by day and a special form of red light by night, would go far toward eliminating fatalities and wrecks at grade crossings, particularly if heavy legal penalties were incurred by those who disregarded the signals. We repeat that, in view of the growing risk to the railroads, it is the duty of the government to investigate this matter at once, with a view to introducing remedial measures.

Soaring Flight

THE TRULY astonishing feats of soaring flights achieved by the German aviators, an account of which is given elsewhere in this issue, calls to our mind a curious instance of this form of flying which occurred many years ago off the Pacific coast, and was related to us by the captain of the destroyer "Paul Jones" who witnessed the phenomenon. It occurred while the vessel was steaming from San Francisco to Portland, Oregon. On leaving the bridge he noticed a solitary seagull was moving with the ship, abreast of the bridge and at a slight elevation above the sea. Returning a quarter of an hour later he found the gull in the same position, and noticed that it was traveling without any flapping of its wings. He found an explanation in the fact that the ship was throwing up an air bow wave, upon which the gull had settled, adjusting the angle of incidence of its wings to give the necessary horizontal component to carry it along at the speed of the vessel.

Assuming that the explanation of this naval officer was correct, and it is difficult to find any other that meets the case, the curious feature is that the bird should have found and preferred this upward air current to those which are found abaft the stern of the ship, where they are due to the heated air rising from the engine room hatchways and ventilators, and to the hot gases from the funnels. No better vantage ground for the study of soaring flight and the sure instinct with which the birds detect and settle upon the rising air currents can be found than at the stern of an ocean steamer.

As yet, man has not developed this air-sense, if we may call it such; but if soaring continues as a fascinating form of sport (and it can never be more than that), it is reasonable to expect that the airman will develop a considerable facility in detecting and passing into the stronger upward currents.

The wonderful soaring flight of over three hours in Germany was made possible by the deflection of a strong and steady wind up the side of a mountain. There is no reason, short of the fatigue of the pilot, why, so long as the wind continues steady and strong, the duration of flight should not be greatly extended. Of the fascination of the sport there can be no doubt, and it has the advantage of greater safety than motor-driven flight; for the pilot need never rise to great heights above the ground, and his landing speeds are so low as greatly to minimize the risk of a crash. Should he lose control, there is no heavy motor to dash him to earth, and no gasoline tank to burst into flames.

Without wishing to detract in the least from the credit due to these German gliders, we must bear in mind that the presence of a steady wind blowing up the slope of a hill or mountain side is ideal for sustained flight. The next step in matching the work of the birds will be to attempt soaring over flat country or over the sea. For it must be remembered that a steady wind and a hillside are not essential for the production of vertical or upwardly inclined currents. The air, even under unclouded sun and in a so-called dead calm, is not at rest, being filled with ascending and descending currents. The dead calm surface of the sea is mottled with alternate glassy and ruffled patches, due to alternate ascending and descending currents. Some day the aviator may learn to soar over the plain or the sea; although having no motor his flights must be brief.

Group of small stone buildings comprising the receiving equipment of the new French radio station. Each building contains a loop and the receiving equipment, connected by land line with the Paris office

From the Bourse to Wall Street

How the World's Largest Radio Station Links Paris with New York City

By Francis P. Mann

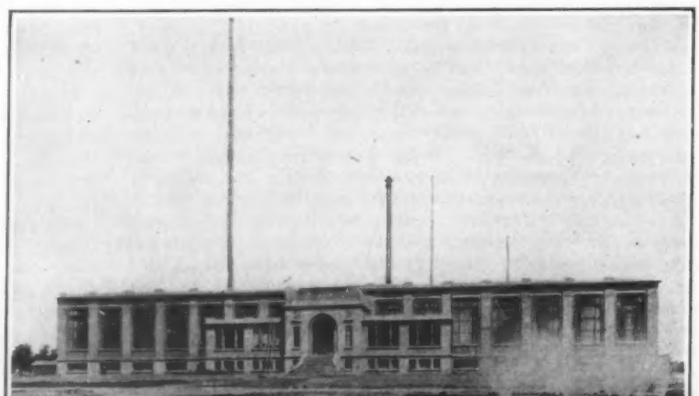
RADIO communication has overcome many of its earlier faults. Back in the beginning of this form of communication, it was necessary for radio to depend to a large extent on the usual telegraph and cable lines. It was depending on its avowed rivals; using them, in fact, to do away with them. This truly inconsistent state of affairs was brought about because the powerful radio stations had to be located in some remote spot where land was available at a low cost. And the radio messages, sent by persons in the centers of population, had to be transmitted by telegraph over land lines to the radio station. The same procedure, in reversed order, took place at the receiving station. Hence the radio messages had to depend twice on the telegraph lines, involving considerable extra expense and, in many instances, rendering the combined radio and telegraph tolls quite prohibitive. The cables, on the other hand, have always given a direct connection between important centers.

Through the development of a system of remote control, it is now possible for radio to connect the centers of population. In the very heart of New York's financial district there is an office that handles radio traffic directly to the most important European centers. Pressing a key or operating an automatic transmitter in that office, an operator is flashing radiograms to Paris or London or Berlin or Warsaw or Stavanger, as the case may be. A nearby operator is receiving radiograms from any one of those European centers. Meanwhile, the actual radio installations are many miles away. The transmitters are located at Rocky Point, in the powerful Radio Central Station, some seventy miles east on Long Island. The receivers are located at Riverhead, Long Island, some eighty miles distant. By means of long land lines, the transmitters and the receivers are brought directly to the New York office.

The latest direct radio connection is between Paris and New York. This is brought about by the inauguration of the recently completed radio station known as the "Radio-France," which is by far the largest radio plant in Europe. Indeed, it is claimed to be four times the size of any of the preceding stations. Besides its large capacity, it has a number of original features. Unlike the radio plants with which we are familiar, it is not centered at a particular point, but consists of a combination of various scattered installations which, however, are grouped together so as to form in reality a single system. What is especially noteworthy is that the main sending station, which is located at Sainte Assise, some twenty-five miles from Paris, is in reality an annex of the main office situated in the heart of the French capital. The office is connected by land wire with the great radio station, and it controls the sending of the messages entirely over the lines by the use of relay and switching combinations which are mounted in the radio plant and act in an automatic manner to connect the oscillating or wave-generating circuits with the antenna.

The radio plant for the receiving is situated in the open country at some distance from the Sainte Assise station, and is occupied with receiving and recording the messages and then transmitting them over wires to the Paris office. As a whole, the new Radio-France enterprise is equipped to handle a traffic of a million words per day.

The main station at Sainte Assise has been laid out especially as a long-distance plant, and can send messages to all countries of the globe such as North and South America, although the latter has not as yet been well reached; then Africa, including the Cape, is also covered, as well as the extreme Orient. The main building, which measures 270 by 70 feet, contains a high-frequency power plant consisting of four groups of motor-driven alternators of the radio type, these being an improvement over what we already described for the La Doua station. Two of these machines represent an unusual capacity, each being designed for 500 kilowatts imput to the antenna, and all the machines can be connected in parallel so as to add their power when long distances are to be covered. Wavelength is controlled simply by changing the speed of the high-frequency generators, and this is considered to be quite an improvement. As before, the high-frequency radio alternators feed directly into the antenna; that is to say, they generate the waves in a direct manner and without the use of any intervening devices. On the other hand, each set of waves at various rates of frequency can be sent out by a separate machine so as to obtain multiplex working, and thus a great number of messages can be handled.



Main building at the Sainte Assise transmitting station, which contains the high-frequency alternators. Note the steel masts which support the aerial

One feature of the station is the huge antenna, and in its general design it consists of a set of horizontal wires properly spaced apart and stretched along for quite a distance, the antenna as a whole being supported by high towers. The makeup comprises twenty strands of wire and extends for about a mile in length in the form of a great sheet, the total length of wire being some forty miles and the weight sixteen tons.

Messages are sent out on an improved plan, with the general idea of automatic control from the Paris end, so that the wires coming into the radio station from the city are connected to high-speed relays whose local circuit controls larger relays, and these serve to operate the switching apparatus for working between the radio alternator circuits and the antenna. No local manipulation is therefore required, and the Paris office can thus send messages all over the world in a direct manner.

As regards the receiving plant, it is located at several miles from the former, and has also many original features. In general makeup, it consists of a main building and six separate receiving stations which are grouped about it. Receiving is done by means of large wire coils or loops, mounted upon movable frames, and these are operated in connection with improved tuning apparatus inclosed in a metal cage. It was especially desired to provide for a highly improved tuning as well as for the best protection against accidental waves, and the receiving apparatus represents the very latest radio developments in Europe.

The value of the close tuning becomes very evident in the efficient working on the multiplex system, which can now be obtained. As a whole, the receiving sets of the plant are operated in connection with recording devices of various kinds and of an improved design, some of which are intended for very high speeds and others for moderate speeds. Messages at the highest speed, as sent out from distant radio plants by automatic transmitters, are recorded by the photographic method with a spot of light and paper strip, the same apparatus also developing the paper and taking care of all operations down to drying. A new type of radio apparatus is based on the principle of the siphon recorder, and serves to take messages at a less rapid rate, while for the more moderate speeds the phonograph method is employed.

We may add a few words about the Paris central office, of which we hope to give a more complete description. Messages are sent over wire to the radio plant by the use of high-speed transmitters of a most improved type. Other apparatus serve to record the incoming messages which were received in the second radio plant. It is intended to handle a very heavy commercial traffic to all countries, and everything has been combined for the highest possible speed, or some 36,000 words an hour.

Trial of Vertical Beam of Light as an Aid to Navigation

IN order to test the value of a powerful beam of white light when projected vertically upward, as an aid to navigation, a 60-inch high intensity searchlight has been temporarily installed at the general lighthouse depot, located at the northeast point of Staten Island, New York Harbor, just below the ferry slips. The apparatus throws a beam of light estimated at 1,400,000,000 candlepower, which swings around the vertical at an angle of 10 degrees and can best be seen at a distance by its reflection on the clouds. This angular movement of the beam is for the purpose of accentuating its value as an aid to mariners where a steady beam of light might not be so readily picked up, and gives it a distinctive characteristic. The apparatus had to be specially modified for continuous service in throwing a moving beam of light nearly vertically. The light is being operated each night from 6 P. M. to midnight, and has attracted much attention.

Solid Substitutes for Hard Coal

WHEN soft coal is burned in a small heating stove of any description, it will be found profitable to buy a stove or heater designed for soft coal. Numerous of these are marketed; the demand will be heavy but they should be procurable. The trick about burning soft coal is that it gives off a lot of gases which escape up the chimney before they reach combustion temperature. By special devices for holding them in the fire-box, for carbureting them as is done in the Bunsen burner or the automobile, etc., they may be retained and burned, eliminating the smoke nuisance and increasing the heat value of the coal. When soft coal is burned in a hard-coal stove this is impossible.

Another solid fuel is coke. Manufactured from soft coal, it might seem that this would be just as scarce as the coal itself. But when fuel is scarce, the coking of coal, with recovery of the gaseous constituents and sale as coke of the solid residue, may be the most profitable way of handling bituminous coal. At no time during the coming winter should coke be more difficult to secure, at wholesale, than soft coal; and at times it will be obtainable when coal is not. If the retail dealer hesitates to handle it, a group of consumers can probably contract for it direct from the wholesaler or even from the ovens.

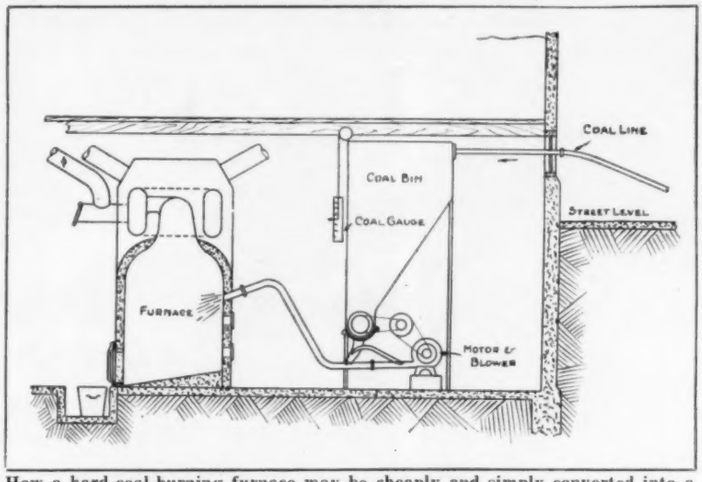
The man accustomed to anthracite will have less trouble with coke than with soft coal. Coke is highly porous: it gets better aeration than any kind of coal and burns up very fast. The dampers, etc., must be closed altogether save when kindling the fire. Air-leaks about dampers, pipes and doors must be carefully sealed: the ones you cannot find will give the fire all the draft it needs. The fire is started by feeding a thin layer of coke on the wood kindlings after these are well lighted. When this layer is burning well, fill up the fire-box and cut down the draft by closing everything you can—*not* by opening the firing door as you do with anthracite fires. In cleaning the grate, leave a layer of ash, an inch or so thick, on the grate, to cut down the draft. Don't let the fire blaze up, with the idea that you can get it under control again. You can't; it will burn out while you are trying.

The light and porous coke is so bulky that many small furnaces designed for anthracite will not hold enough coke to keep the fire going all night. The remedy for this is to buy such hard or soft coal, in pea or even buckwheat sizes, as may be available. Use this for banking, burning the coke through the day when a real fire is wanted. The same expedient will be of much utility in stretching a supply of real coal; and buckwheat coal ought to be procurable at almost any time and place.

If the difficulty were wholly one of production, the burning of low-grade coal salvaged from culm piles would help a lot; but the transportation angle prevents too much use of this expedient. Still, low-grade coal will be offered, and may be burned effectively if properly handled. One way to handle it is in briquets, with oil added to serve as binder and to increase the fuel value. This is extensively done in Europe; on this side it has been more of a stock-jobbing proposition than anything else. Don't buy briquet stock; but buy briquets when they are offered. Usually they require nothing special from the furnace save perhaps a modification of the draft.

When coal has been pulverized so that it will float in air as a dust cloud, its properties become largely those of a liquid, and it can be treated as a liquid fuel would be. Burning and regulation is then much as with oil-burning, save that the noisy high-pressure blast of air or steam is absent.

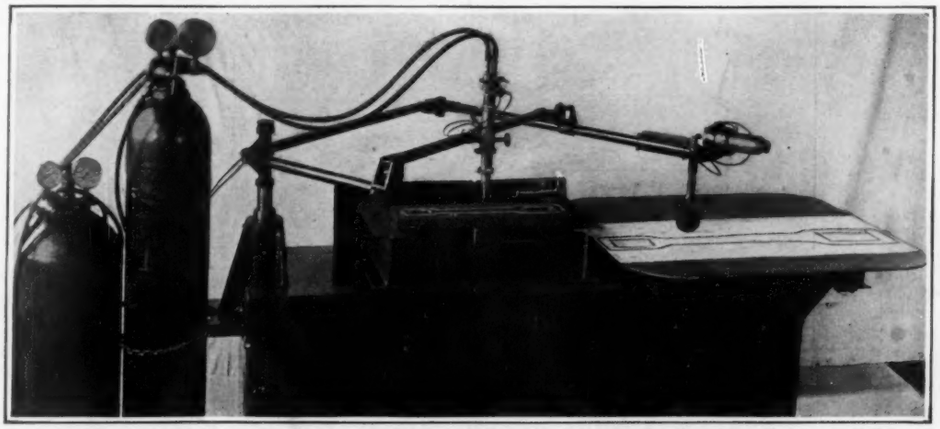
This practice is by no means in the experimental state. It has been followed for 25 years in the firing of cement kilns, and right now ten million tons of coal dust are so used every year. The requirement is that 85 per cent of the mass must pass through a 200-mesh screen, and 95 per cent through one of 100 meshes (to the inch). A cubic foot of such coal presents 10,000 square feet of surface at the very least, against six square feet for the same coal in a single lump. This is why the pulverized coal attains a completeness of combustion which lump coal can never match. In ordinary household practice it is not unusual to find 20 per cent of combustible in the ash; with powdered coal this figure is practically zero.



How a hard-coal-burning furnace may be cheaply and simply converted into a powdered-coal burner to tide over the emergency

If the pulverized coal process were being developed commercially, a specially designed furnace would of course be offered; but for emergency use no alteration need be made in the conventional furnace beyond the removal of the grate and the insertion of burners in the ash-pit door. A peak-load capacity of 12 pounds of coal per hour, with the necessary 175 cubic feet of air per pound, would be ample for household heating. A blower of 25 cubic feet per minute under one-ounce pressure would be suitable; and this could be driven by motor from the lighting current. The blower and motor are standard equipment with some makers of powdered-coal-burning apparatus or of electrical machinery.

In starting the fire from the cold, a bonfire of paper, kindling wood, charcoal, etc., must be made in the ash-pit; and when this is burning briskly, the motor is started and the jet of coal will light almost as readily as the ordinary gas burner. In starting up after a short interruption the fire-box will usually be hot enough to cause ready ignition. Regulation is by thermostat, or even by hand. In the emergency of a winter when commercial electric current may fail from time to time, provision should be made to burn wood in the ash-pit or on the temporarily restored grate.



A pantograph machine to guide the cutting torch as the index wheel rolls along the lines of the original drawing

Chromatic Vision and Color Theory

IN *Science* for May 26, 1922, Dr. Christine Ladd-Franklin presents an extremely interesting paper on "Chromatic Vision and Color Theory"—a further development of the theory that for some years has borne her name. The author states and discusses her theory of chromatic vision in brief as follows:

There is probably no other organ in the body in which the record of development has been preserved in such a remarkable fashion as in the organ of vision. We have, *pari passu* with the successive stages of specificity of response to the visual spectrum, namely of white, then of yellow and blue, and finally of red and green, (1) an anatomical development of rods into cones, and (2) a chemical development of the rod-pigment sensitizer such that in man only is there an intermediate stage, the visual yellow, between the "visual purple" and the final leuco-base. What is more natural, then, than to suppose that there has been also a development of the light-sensitive receptor substance in the receptor organs (rods and cones) of the retina? This developing substance must, however, be at the same time of such a nature as to account for the singular fact that the colors successively developed are disappearing color pairs. If these facts are held distinctly in mind the appropriate chemical conception almost forms itself.

This conception is as follows: The development is that of a greater and greater specificity to the electro-magnetic vibrations of the visible spectrum. A portion of a molecule which at first is broken off indifferently by the whole spectrum becomes in a second stage more specific—by a fresh aggregation of atoms a portion Y responds to the yellow end of the spectrum, a portion B to the blue end of the spectrum. But what happens when yellow and blue light fall at once on this chemical substance? The Y and the B [since they are the chemical constituents of W (white), because the assumption is that they were segregated out of it] will chemically unite and will produce W, the nerve-excitant of the sensation white. In the same way in the third, and latest, stage, the newly segregated R (red) and G (green), when torn off from the molecule by light of low and of high middle frequency, will revert to the mother substance Y; and if light of high frequency, "blue," is now added, we shall again have the nerve-excitant of white. That is to say, just as when we have in a test-tube the chemical constituents of HCl (namely, H and Cl) they chemically unite, under proper conditions, and produce HCl, so in a cone we have

$$R+G=Y$$

$$Y+B\ (=R+G+B)=W$$

This explains how it happens that lights of only three specific, homogeneous wave-lengths ("red," "green" and "blue") are sufficient to reproduce the whole gamut of color sensations, including yellow and white. Yellow is a secondary product, and so is white, but they are both perfectly good unitary sensations. The theory explains at the same time, of course, how it is that the primitive white mediated by the rods is the same sensation as the white compounded of other colors.

In conclusion the author says that the advantage of the new theory is that it is "in line with the most recent conceptions of the chemists—Bohr, Soddy, Rutherford, Mathews, Willstauer and many others."

The Oxy-Acetylene Pantograph

TORCHES for cutting metal may now be had, electrically or mechanically controlled by remarkable machines which not only advance the cutting flame at a given rate, depending upon the thickness of the metal, but also guide the flame accurately in either straight or curved lines and cut the metal according to a given pattern.

In the illustration such a machine is shown with the torch attached to a pantograph to reproduce half-size in metal the drawing on the table. A small connecting-rod has just been cut out, the swivel wheel having been run over the lines of the drawing to guide the torch. Just above the wheel is a miniature electric motor that provides the necessary motive power. At the left of the picture are the gas receptacles with their gages and indicators.

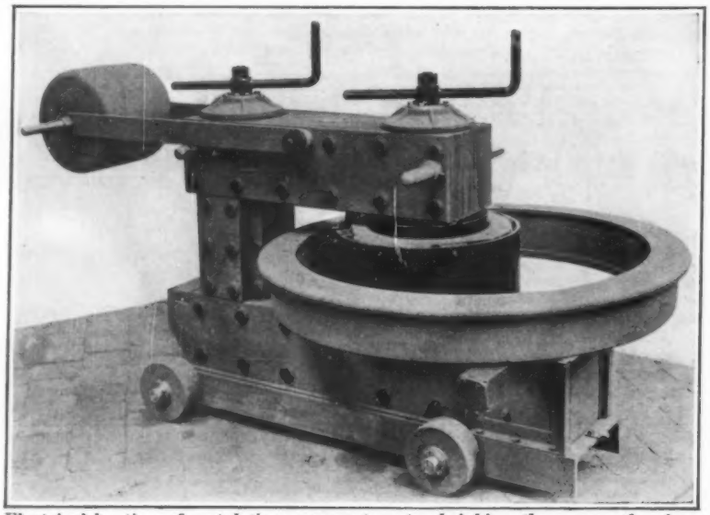
Measuring the Load on Locomotive Wheels

OBSERVATIONS of a very practical nature may be carried out upon locomotives and cars by means of the new apparatus which has been brought out by a Swiss firm and is intended to afford a very ready means for measuring the load upon the vehicle wheels at all times and without requiring the use of complicated devices. The object in this case is to determine the various data with reference to the tension upon the springs of the vehicle, these being of great use in the proper designing of the latter, both as regards the general construction and, again, as concerns the regular wear of tracks and wheel tires. This latter will depend to a considerable extent upon the general value of the pressure of the wheels on the rails of the track and the uniform distribution of the load upon the car axles. In modern locomotive and car building it is therefore of quite a little importance to obtain practical figures relating to the load upon the axles, or, more properly, on each of the wheels. The apparatus can also be put to a very good use in making the final tests after a car, for instance, has been constructed and is ready to be put on the road. Equality of the load upon the wheels is an important feature to be looked after in the final inspection of the car, and the new device will enable this to be carried out in a very ready manner and with a considerable saving of time.

We are indebted to M. Alfred Amsler, the inventor of the present apparatus, for the following description, it having been constructed at the Schaffhouse works. The device is of a compact design, one of the main points being to secure a strong and practical makeup. It consists of a carriage adapted to run upon rails in a pit which is located between the railroad rails. The top cross-bar of the carriage is intended to come up against the vehicle wheels and to take the load, the pressure being transmitted from the cross-bar by a suitable mechanism to the measuring devices, the pressure upon each wheel being read upon the corresponding dial. During the operation of measurement upon a vehicle, the latter is allowed to remain in the stationary position, while the apparatus is run along on its rails so as to be brought under each axle; that is, under each pair of wheels. In this way the vehicle does not require to be moved during the whole operation.

The measuring apparatus is constituted by two similar hydraulic presses as shown, in which oil is employed, the two pistons being adjusted in the cylinders with a great precision so that no stuffing box is required to secure the tight working. The movement of the pistons is thus effected without friction, whence it will result that the pressure of the oil in the cylinders gives an exact measurement of the load on each hydraulic press. The pistons are caused to bear up at the ends of a cross-bar whose outer portions are obviously adapted to come under the vehicle wheels in order to take the load. These end parts are mounted in a socket bearing so as to swivel about on the end of the main bar and thus allow of a good adjustment under the car wheel. The transmission of the effort between the piston and the main cross-bar is carried out through a solid vertical cylindrical piece of an upright so disposed as to effect a perfect centering during the test, and in this manner the piston is not subjected to any lateral thrust. The main cross-bar is in turn secured by a pair of trunnions to a cap which is connected with the piston through the above-mentioned upright and thence to the piston of the cylindrical press, and this arrangement prevents any side movement of the various parts.

The two pistons are each connected with a hand pump and the latter is readily operated in order to force oil into the hydraulic press on each side, thus raising the main cross-bar and finally the car wheels. The pressure of the oil in each hydraulic press at the moment of lifting the wheels is the equivalent of the load upon the wheel on each side, the amount of this load being read upon the two indicating dials of the pressure gages which are graduated in tons. The presses are relieved and the cross-bar let down, by opening the release valves shown. The apparatus is provided with special hooks on which standard weights can be suspended for checking up the accuracy of the oil pressure gages at desired intervals.

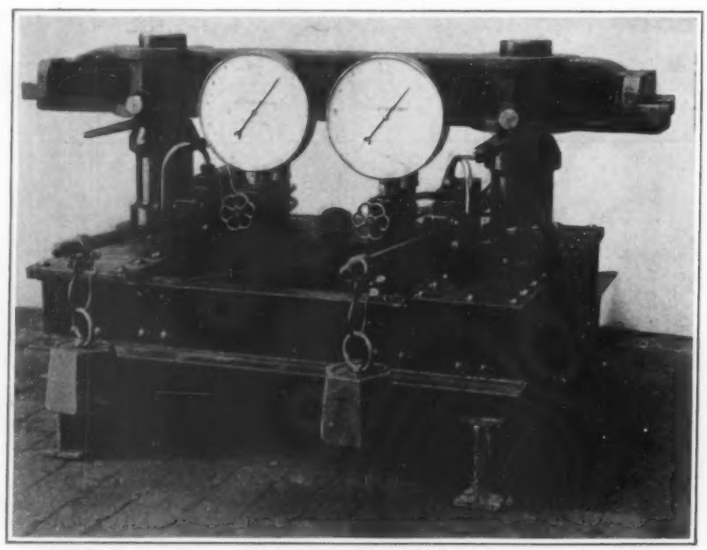


Electrical heating of metal tires preparatory to shrinking them upon the rims

Electric Tire-Heating Apparatus

METAL tires are generally mounted by the shrinkage process, the diameter of the tire in the cold state being somewhat less than the wheel diameter, the difference depending upon the pressure which is to hold the tire in place. The process is carried out by heating the tire to a sufficient temperature to produce its expansion by a certain amount so as to allow of mounting it upon the wheel. Heating by coke or charcoal furnace is still employed for the purpose, but the heat is by no means as uniform as might be desired, and the pieces require to be cleaned afterwards on account of the effects which are due to smoke and ash. An improvement was found in gas heating, and a relatively simple device can be used, consisting in a ring tube of somewhat larger size than the tire and having a set of small gas jets around the inner side which heat the piece or the tire when it is placed within the ring. But this method has not come into extensive use, for it requires compressed air for the supply to the burners, and this means quite a good-sized plant with compressor and motor, besides the piping; then, of course, the same device will only serve for pieces of a given diameter.

The electric tire-heating apparatus, which is a recent product of the Swiss Oerlikon works, will now overcome the drawbacks of the old systems. It makes use of the well-known principle of the induction transformer, which is also the same as is used in the induction furnaces employed for treating metals. Any ring-shaped piece is suitable for the purpose, and it forms the short-circuited secondary winding of a transformer, acting with a primary coil having a variable number of turns, so that the current will produce the heat which is necessary for the expansion of the ring. The heating takes place in a gradual and regular manner, and the time required to obtain the desired temperatures can be easily regulated by the use of various terminal connections of the primary winding. It is found that the electric method is very economical, especially where current is to be had at reduced rates, and the work is more exact and cleaner. Our illustration shows the new apparatus which is of very strong build and is mounted after the manner of a wheeled truck for use in factories. Upon the truck platform is mounted the transformer which is built up of laminated iron with top and bottom part and two vertical cores. On one core is mounted the primary coil, and the terminals of the various sections of the windings are placed in a small sheet-iron box. The primary coil is surrounded by a heat-protecting covering as well as a metal band, so as to protect it from mechanical shocks as well as from heat radiated by the piece of work. The second core of the transformer is left bare, as will be noticed. In order to insert the tire or other piece of work, the top part of the transformer works on a pivot so as to be turned about, and is also balanced by a counterweight in order to ease up the movement and to take the weight off the surfaces in contact. The pivoting can be carried out upon one core or the other, according to the case. Should the piece of work be small enough to go around the bare core, as for a tire, it is placed in practice around the primary winding. The present apparatus is constructed for single-phase current on a 500-volt circuit and a frequency of 40 or 50, and is made in two sizes, the largest weighing some 1.4 tons and heating a tire of 6 feet 8 inches of 1210 pounds weight. The time of heating for large tires of the railroad type is from 20 to 30 minutes.



Simple Swiss apparatus for determining the load upon vehicle wheels

A Direct-Drive Diesel Engine

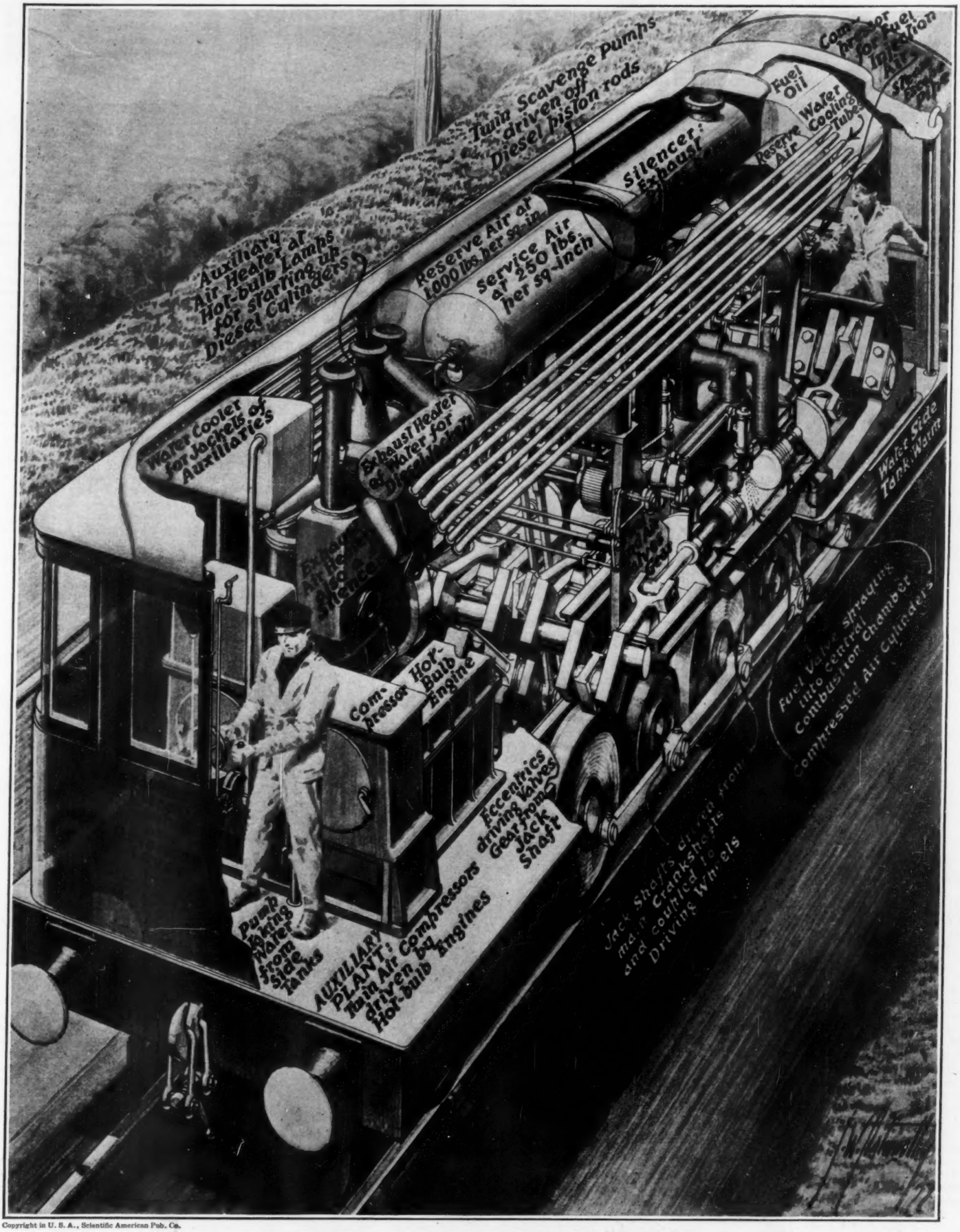
THE great advantage in fuel economy which would be possessed by a successful Diesel locomotive is leading engineers to consider it as a possibility. Probably the soundest design yet produced is that pictured on the facing page, proposed by Mr. W. S. Burn, M. Sc., and recently described by him before the North-East Coast Institution of Engineers and Shipbuilders, in England.

The outstanding difficulty for such work is the Diesel's lack of flexibility, it being, at present, essentially a one-speed engine. Most previous designs have added this quality by introducing the costly and complicated electric drive.

The designer has here, however, incorporated every feature of different existing Diesel types tending to increase flexibility, with most promising results. These include opposed pistons, hot piston heads, an approximately spheroidal combustion chamber, a constant-pressure cycle, hot-water jackets, both when running and starting, and hot scavenging air prior to starting, all to induce a sufficient temperature for fuel ignition at as low a speed as possible; also every practicable device to control the fuel injection to suit different speeds and loads, and to enable the locomotive to run equally well in either direction.

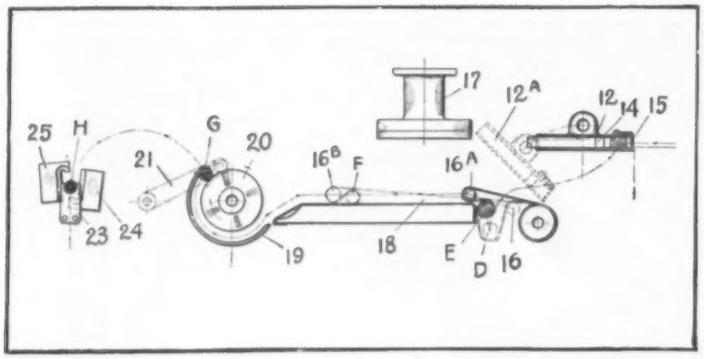
Diesel cylinders, unlike those of the ultra-reliable steam engine, must be readily accessible at all times, and are therefore placed entirely above the frames. They are horizontal because a vertical engine of equal power would exceed the height limit. The Diesel engine cannot start up at less than 4 M. H. P., and for lower speeds the auxiliary compressed-air plant is provided. It is intended that one of the hot-bulb engines should run continuously, the other acting as a standby. The compressed-air cylinders start the locomotive and furnish additional power when the Diesel comes into action. The air is heated in transit, thus applying no less than 80 per cent of the power of the hot-bulb cylinders. Highly compressed air is stored in the reserve bottles as supplementary power for peak-load periods.

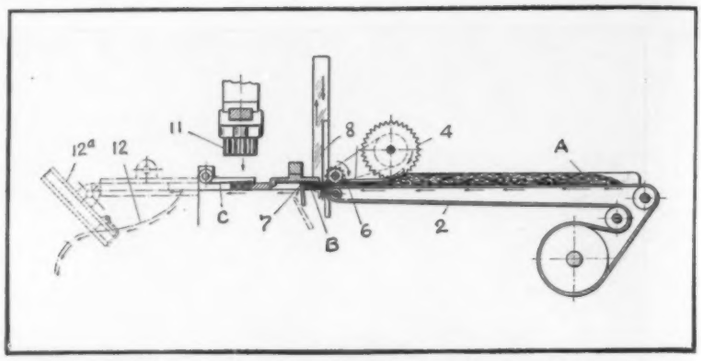
There are two operators, a driver and a mechanic, corresponding to the usual engineer and fireman.



DIRECT-DRIVE DIESEL LOCOMOTIVE OF NOVEL DESIGN PROPOSED BY A BRITISH ENGINEER

(See facing page for description)





These two drawings, to be read clear across from the right of the page to the left, show the successive steps in the first two phases of the cigar-machine's operation. Numbers refer to the parts of the machine, letters to the successive positions of the cigar-to-be

When Gears and Levers Replace the Cigar Maker's Adept Fingers

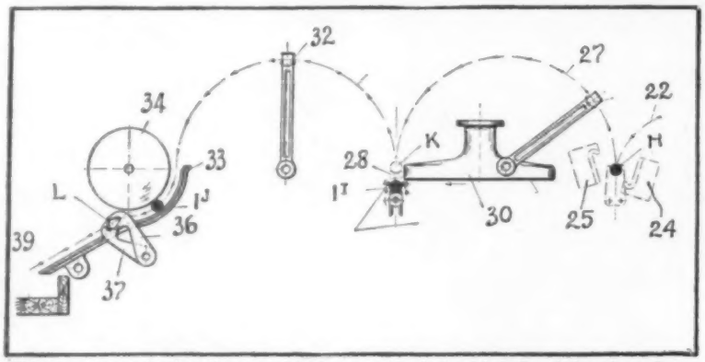
AMONG cigar manufacturers, the cigar-making machine has for years held the same place that perpetual motion occupies in the engineering world. The machine cannot handle the delicate wrapper successfully; it cannot do all the work of making a cigar, but has to leave so much to hand operators that its use is no economy; what it does do is so miserably done that it would get past the user only of the very cheapest smokes; and so forth. A thousand and one perfectly good reasons have been always on tap why cigars would never be made by machine. Which is perhaps as good a reason as any why they are now being made by a machine—made in all grades, with the most delicate of wrappers, and with a perfection of form and finish equalling the finest hand work.

The machine which does this is sufficiently complicated to addle the brains of the most courageous draftsman or patent attorney. We show a photograph of the entire assembly, to show what it looks like in operation; but when we come to diagramming its working, it becomes necessary for us to pass to a simplified diagrammatic treatment, which shows in a general way what the machine does without going into all the details.

The operation is continuous; the cigar-to-be passes without a break through the machine, from the trays in which the tobacco for filler and wrapper stands waiting to the station at which the finished cigar is discharged. The machine is all in one piece; there is no break either as regards time or space. But the work done falls so naturally into three sections that, for clarity of drawing, we have split the machine into three. The first diagram covers the operation of preparing the filler and bringing it to the point where it meets the binder—which for the sake of the uninitiate may be described as a sort of rough inner wrapper. The second phase runs from the application of this binder through the shaping process which its presence around the filler makes possible. The third series of motions has to do with the assembling of filler and wrapper, and the fixing of the latter in its place.

In plate A, a girl operator stands at the extreme right, in charge of the feeding of the filler to the machine. She does not have to separate the filler into individual cigars-to-be; she merely keeps it evenly distributed over the moving belt 2, smoothing out the mass of the filler-leaf A and keeping it replenished. The cutting off of the individual charge for each cigar is done by the machine; as the belt 2 moves forward (to the left), the filler is engaged by the toothed wheel 4, and carried forward in a compressed state under a guide and against a smaller toothed wheel 6. It advances to a position against the "measuring fingers" 7, as indicated at B. The tripping of the fingers 7 to the position indicated in dotted line stops momentarily the feeding of the filler, and a knife 8 descends and cuts through the filler, separating the predetermined quantity, which is now spoken of as the "charge," to emphasize that it is just the right amount for one cigar. The tripping fingers can be regulated for any desired size of charge. This cut-off charge is carried forward to the position C, under the teeth of the corrugated cutters 11. When these descend and trim off the ends, the first step in actual shaping has been performed. The charge is then pushed forward into a transfer mechanism 12, shown in phantom in the first drawing, and in full line in the second. With its delivery to this transfer, the first phase is complete.

The charge is held firmly in the transfer by a plunger 14 and a gate 15, while the transfer apparatus moves forward (still from right to left) as indicated by the dotted-line path. It passes through an intermediate position 12A, somersaulting as it does so, so that when it reaches its final position the charge, originally at its left end, has been brought around to the right as indicated at 16A. During this transit the roller belt 18 is carried over and around the charge, and drawn taut. This gives the charge a roughly round form, as indicated at E, where it is shown enveloped by the belt, contrasted with the roughly square form D which it has had to this time.



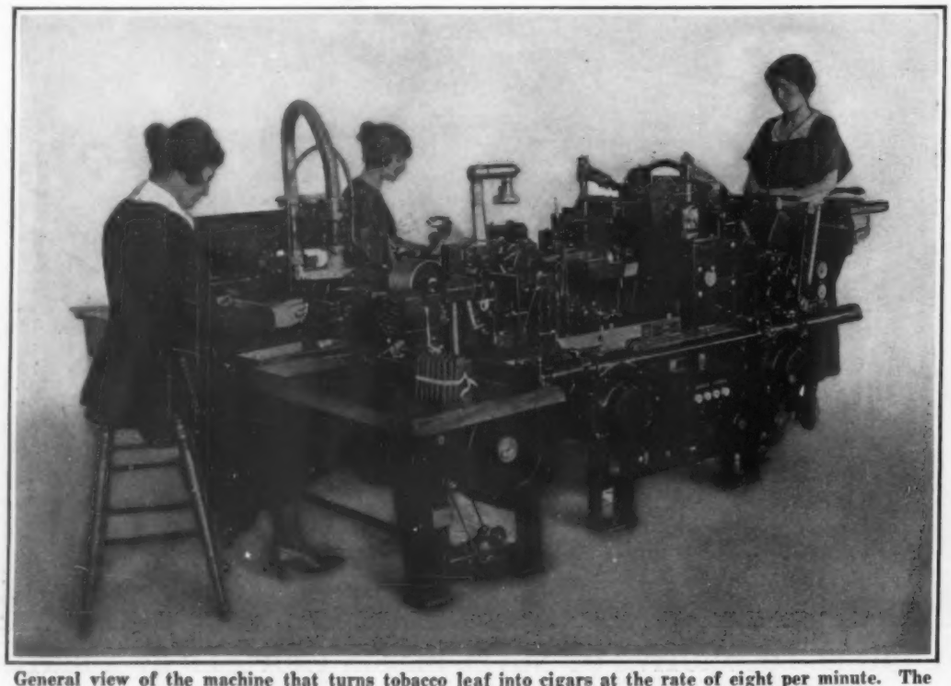
This drawing, which follows right along to the left of left-hand drawing above, shows how the "bunch" is got into the wrapper and given the final touches to make it a perfect cigar

While the first sequence of operations has been going on, a second girl, at the binder station off to one side and out of the drawing, has cut a binder leaf to the approximate shape required and has placed it on a smooth surface before her. Here it is subjected to a slight suction from below which smooths it out; and then the suction arm 17 descends upon it, the suction from below is relieved, and the arm moves away with the leaf firmly clinging to its under surface. The arm 17 then makes a long reach across the machine, and while the transfer 12-12A-16 is taking place, it brings its burden down upon the belt 18. The suction broken at the psychological instant, the arm moves away and the binder leaf remains spread out flat on the belt, waiting for the charge.

The roller 16A now moves forward over the belt 18 to the position 16B. By an extraordinarily ingenious arrangement, this draws the loop of the belt 18 in which the charge E rests along the belt itself in such a way that the charge, still tightly held, rolls over the (lightly gummed) binder leaf and picks it up, at the same time wrapping itself tightly in the binder. This movement really has to be seen to be appreciated; it is the most attractive feature of the machine, to the eye, but is utterly indescribable. At the end of this operation the roller is at 16B and the tightly wrapped charge at F; and the term "charge" is now dropped in favor of "bunch."

The bunch now leaves the belt 18, and moves around between the concave plate 19 and the softener roll 20. The space between the two is adjusted, according to the dimensions of the cigar under construction, so that any irregularities in the bunch are smoothed out, while at the same time the

(*Continued on page 366*)



General view of the machine that turns tobacco leaf into cigars at the rate of eight per minute. The operator has stepped aside, as her presence would have obstructed the view of the machine

Irrigation and Water-Power in Palestine

By Henry Woodward Hulbert

FOR MANY years the water-power possibilities of the vast depression of the Jordan Valley in Palestine have been evident to all engineering observers, and especially since Lieutenant Kitchener (later Viscount) completed the survey of Western Palestine for the Palestine Exploration Fund. That strange river rises but a few hundred feet above the level of the Mediterranean and soon is checked in its course by the extensive morass of the Huleh Basin. As this can never be drained successfully, it furnishes the first opportunity for an extensive barrage, below which is a drop of 700 feet within a 10-mile course to the Sea of Galilee. At this point it is certain that many hundreds of thousands of horsepower can be generated.

The second power house in the system would be constructed at the outlet of the Sea of Galilee, where a barrage can be thrown across the Jordan as it issues from that huge basin. This would hold the waters of that sea at least at high-water mark. Possibly it may be found that the level could be brought two or three feet higher without serious damage to the shore privileges. Here again many hundreds of thousands of horsepower could be generated.

In the 60 miles (as the crow flies) from Galilee to the Dead Sea the drop is about 600 feet. The waters of the Jordan may well be diverted at this point from the winding channel and carried down by canals on either side of the valley at proper levels for irrigation purposes. There is no richer or more neglected land in the world that would thus be opened for cultivation. A considerable body of this water must be carried 30, 40 or even 50 miles for use in the lower valley and can be used at every drop to generate more electricity.

Three considerable perennial streams flow into the Jordan and the Dead Sea from the east below Galilee, the Yarmuk (Hieromax), the Zerka (Jabbok) and the Arnon. Here again large irrigation opportunities present themselves and incidentally water-power privileges. The first two of these and other smaller streams from east and west should be led into the two canals carried down the sides of the Jordan Ghor at high levels. Possibly a total of a dozen barrages across the mouths of wadies coming down into the valley could impound all extra fresh waters and receive the spillover from the canals during the rainy season (November to April). The plan would be to use up entirely the fresh water of the Jordan system, so that eventually none of it shall flow into the Dead Sea. By the power generated, water could be pumped to reservoirs at high levels on either side of the Jordan Valley, thus greatly extending the irrigation of rich soils never yet brought under continuous cultivation.

In all this we have only the ordinary scientific handling of a river system for highest agricultural and water-power purposes. But in discussing the Jordan Valley we have the absolutely unique situation of a river rising but a little above sea level and spending its complete course in descending ("Jordan" means "the descender") to the depth of 1300 feet below the sea level. At one point this strange depression approaches the inexhaustible reservoir of the Mediterranean within 25 miles, five of which lead through the rich alluvial plain of Acre to the foothills of Galilee, leaving only 20 miles of tunneling through soft limestone to the Jordan watershed, whence the waters of the Mediterranean can be carried down the 1300-foot descent to the Dead Sea through a straightened riverbed by a system of barrages by which to extract from the descending mass of waters the last degree of horsepower possible.

When, some years ago, the experiment was broached of letting the Mediterranean waters into the Jordan depression by a canal via the Kishon Valley and filling up the whole valley of the Jordan and then cutting through the intervening barrier from this inland sea to the eastern upper prong of the Red Sea for ship canal purposes, paralleling the Suez Canal, the whole project, after careful investigation, was given up. The engineers, granting that levels and cuttings were quite practicable, brought in the verdict that so great was the evaporation in the deep Ghor of the Jordan Basin no plan could be devised that would let in water fast enough to fill it up. This being the case it is clear that the Mediterranean water can be thus turned into this deep depression up to the limit of its evaporating possibilities. This can only be determined by experiment, but there cannot be any doubt that the amount of electrical fluid thus to be generated would surpass many times over the total capacity of the Niagara tunnels.

The amount of water-power thus available cannot easily be estimated. The complete using up of the fresh water of the Jordan system in irrigation plans would leave a maximum of evaporation in that semi-tropical valley brought to bear on the Mediterranean water to be let in. Every available basin not otherwise used for agricultural purposes could be utilized in extensive salt works. Whether the water used for this purpose should come from the Dead Sea by pumping it up to high levels or from the Mediterranean water as it comes down would have to be determined according to local conditions. Large barren regions to the south of the Dead Sea would doubtless be available for huge salt-making basins.

The power generated by the Jordan system itself and by the still larger use of the Mediterranean reservoir would light all the cities and villages of the land, propel all the railway lines and furnish energy for manufacturing purposes widely over the regions east and west of the Jordan. Every household would find it available for private use in the home, shop and on the farm. Of course manufacturing centers would be located near transportation opportunities by rail and boat, and where power could be had at the lowest rate.

Ever since Napoleon stood baffled before the gates of Acre it has been recognized that the military key of the country lay there. Subsequent events make plain that there also lies the industrial and commercial key as well as the transportation center. Here is the only natural harbor in Palestine. At present it is choked up with sand and at some seasons is a dangerous roadstead. But a ship canal to the foothills of Galilee and a strong current sweeping through it to the east to the proposed tunnels quite change the conditions. It would be a comparatively easy engineering feat to build projecting jetties from the end of Carmel and from Acre, to dredge out a deep outer and inner harbor, to fill in the bay so as to give both Acre and Haifa an inner harbor also, and to make a modern seaport of the first class.

A new manufacturng city should rise back of the commercial city on the Acre plain and on the foothills of Galilee, a city without a chimney to blacken the air, and so placed as to command the raw material needed for its busy activities. Cotton would come down the Nile Valley and from Mesopotamia, wool from the whole back country, hair of goat and camel, silk from the whole Levant, olive oil more and more plenteously as the country recovers itself, wood, leather and many other kinds of raw material.

It is certain that the plans outlined in this brief article can only be effectively carried out by the reorganized government in that land. It only could unify and harmonize all the problems involved. The Jordan Valley is too big a proposition for private ownership. The rights of eminent domain would have to be exercised freely to get the enterprise started and to keep a firm hand on its development. The people as a whole should have the benefit of this great natural resource. Later, private ownership might prove wise in part, but long leases of land and power would seem to be the natural way of development. Best of all would it be if the whole benefit could accrue for educational improvement. It would be one of the finest educational endowments in the world for all the future and, as well, a benefit to everyone who would have to do with it.

Of course all this calls for time and patience and patriotic service. First the Sea of Galilee must be raised by a barrage at its southern end. This would give electricity by which to run the Haifa-Damascus railway and power to work out the succeeding problems up and down the Jordan Valley.

Conserving Crops by Fumigation

By Benno Lowy

PERHAPS nothing in the agricultural industry has been given so little publicity as fumigation of pest-infected cereals. A peculiarity in nature's own domain is the fact that wild growing plants are as a rule less liable to destruction by insects, while cultivated crops fall easily a prey to animal parasites.

When an agricultural product becomes a vital part of man's food, protection against destruction becomes the more obviously necessary. This protection is given in various forms, as, for example, by sprays that contain poison which is squirted on the plant. An insect feeding on such a plant consumes enough of this poison to be killed almost immediately. Some insects, however, such as scales and mites, penetrate the surface of the plant and draw off the sap; such parasites are killed by liquids or gas which attack the insect from without.

In the matter of cereal infestations, conditions are somewhat more complicated. Limiting this subject to rice and wheat products, the following parasites are to be encountered: Flour beetle, meal worm, grain weevil, rice weevil, Mediterranean moth, saw-toothed grain beetle and grain moth. Some species of weevils lay their eggs into the blossom of the cereal in the field; this egg is dormant while the blossom develops and does not breed a larvae until the plant is fully grown and perhaps harvested. Sometimes infestation occurs while the cereal is in stack and it is a good policy to thrash the grain soon after harvesting to avoid insect troubles.

The most powerful weapons with which these pests can be fought either in the mill, warehouses, grain bins or other storage places are hydrocyanic acid and carbonbisulfid. The former is now being used in preference to the latter, although, as pointed out below, their use should be governed by individual conditions of the material which is to be fumigated.

Hydrocyanic acid is one of the most deadly poisons known to chemistry; the inhalation of one deep breath kills men almost instantly. Unfortunately, some of the insects to be fought have a certain resistance to the gas, and in fumigation the basis of strength of the gas has to be varied according to the pest which is to be exterminated. Thus, it takes less gas to kill mice, rats or flour moth than it takes to kill beetles or weevils. And while, in the fumigation of mills or warehouses, the manipulation appears rather simple to the layman, I would warn anyone against attempting such a job without the supervision of a chemist or a person who understands something about evolving poison gas. A considerable danger source appears in the fact that the gas is almost odorless or at least has no unpleasant odor, resembling faintly bitter almonds. The gas is lighter than air and rises rapidly, hitting the ceiling and then spreading slowly over the space that is to be fumigated.

Carbonbisulfide is also frequently used, especially where the space to be fumigated is full of cracks or crevices in the floor. The liquid volatilizes quickly, the fumes are three times heavier than air (unlike cyanide gas). One volume of the liquid gives about 250 volumes of gas. The liquid can be spilled on edible material without any injury. It is colorless, heavier than water and is manufactured by passing sulfur fumes over heated charcoal. The resulting gas combustion is then condensed by cooling to a liquid.

In fumigating with carbonbisulfide, the liquid is simply poured into a shallow tray which is suspended near the ceiling. The liquid vaporizes rapidly and the gas sinks gradually to the ground. Hydrocyanic gas, however, is a far more effective fumigant. In fumigating a space, be it a mill, warehouse, ship bottom, grain bin or railroad car, the first thing to do is to close up all crevices and holes by placing wooden boards and paper over them. It is equally important to sweep the floors, corners of the building and spaces under machinery, conveyors and elevators and keep the sweeping so gathered in one pile. If the walls of the building are rough, so as to permit dust to accumulate, they should be swept clean. Dust and dirt are the very breeding media of the insects which are to be exterminated. Whitewashing of the walls is very effective if a thorough job is to be performed. Then, care should be taken that a few windows of the building are fastened in such a way that they can be opened from the outside. Dust collectors, rolls, elevator legs and any machinery containing doors should be laid open to allow the gas to enter.

Hydrocyanic gas is evolved from sodium cyanide, a white solid chemical that is commercially obtained in round lumps, weighing one ounce a piece or in broken-up pieces. Care should be taken to purchase only the high concentrated sodium cyanide, as inferior grades do not produce sufficient gas.

The gas is evolved by placing the cyanide in sulfuric acid. Just as soon as the cyanide lumps strike the acid the gas is vigorously generated. The amount of solid cyanide to be used depends also on the condition of the building; an air-tight building needs less gas and a loosely-built structure will naturally permit some of the gas to leak out; therefore, more cyanide has to be used. The lower and upper limits are: 10 to 16 ounces of sodium cyanide per 100 cubic feet of space.

A Big Job in Fine Dimensions

Making the Millions of Matrices for Type-setting Machines

By James H. Collins

THIS page is printed from machine-cast type, each letter being formed in a brass matrix. Suppose a single matrix, like one for the letter "e," out of perhaps fifty similar matrices, had a defect discernible only under the microscope. That defect, repeated throughout the page, would be noticeable to every reader.

It is to such fine dimensions that matrices for type-setting machines are made—the tolerances are as fine as one-eighth of a thousandth of an inch.

An average type-setting machine requires from one to two thousand matrices to the "font" or single style or size of type. There are hundreds of separate "fonts" not merely of body type, but display type, borders and ornaments, as well as types for foreign languages. The American type-setting machine has gone around the world, so the matrix requirements run into millions. For one of the most widely used type-setting machines, more than one thousand different fonts are carried in stock, the matrix department has a capacity of 1,000,000 matrices weekly, and fully 100,000,000 are kept at branch depots in this and other countries to fill orders.

And that is the magnitude of the job.

It has been said that the modern type-setting machine would have been impossible without another invention made about the same time—the Benton engraving machine. When type was set by hand, the engraver cut for each letter wanted a single "punch" in steel. This punch, with the required letter on it, was pressed into a block of brass, making a matrice or mold from which type could be cast. With one punch, hundreds of molds could be made, so one usually sufficed. These punches, cut by hand, were costly, for punch cutters were well paid, and the work so painstaking it often took a year or more to cut the punches for a new style of type in various sizes.

When inventors like Mergenthaler and Lanston developed machines that would cast type instead of setting it, they created an unheard-of demand for punches. The type founder uses his punch to make one matrix and carefully stores it away in a fireproof vault. The type-setting machine punch, on the contrary, is put into steady production, making matrices in quantity, until it shows wear or breaks, when it is replaced by another. Quite apart from the enormous cost of cutting such numbers of punches by hand, there were not enough manual punch cutters in the world to do even a fractional part of the work that was now called for.

Fortunately, the necessary device had been invented and was ready, the engraving machine invented and patented by L. B. Benton, a Milwaukee type founder, in 1885. Its principles are utilized in the batteries of engraving machines used to produce the millions of matrices needed for type-setting machines. Inventive by nature, Mr. Benton had gone to New York seeking a punch cutter, but was unsuccessful in persuading one to move to Milwaukee. Thereupon, he turned his thoughts toward a machine that would do such work, and ultimately hit upon the idea of making matrices without punches. If the desired letter could be cut in soft type metal, an electrotype shell made from it, and the shell backed up with brass, it would form a satisfactory matrix from which to cast type. Manual skill was needed even for cutting such a letter in type metal, just as an artist needs manual skill to make an original drawing. But with a pantagraph, anyone can make a copy of the artist's drawing. Could the same principle be applied to matrix making? The inventor found that it could, utilizing the principle of the pantagraph and also that of the gimbal ring. It was fairly easy to make a large model. This model was then put on the bed of the engraving machine and its lines followed by an operator with a tool. By pantagraph mechanism and an adjustable device, a cutting tool in the upper part of the machine reproduced the letter in type metal in any size desired. A great deal of patient experiment was necessary before the machine did satisfactory work, for after developing the pantagraph and gimbal ring principles, the inventor found that the cutting tool necessary to do the work had to have an unusual arrangement of cutting edges—this tool is microscopic in size, and grinding is one of the most important factors in the work of the engraving machine. Another problem was to devise mechanism fine enough to make such a tool faithfully follow every movement of the operator, a difficulty solved by using a jeweler's lathe as a chuck.

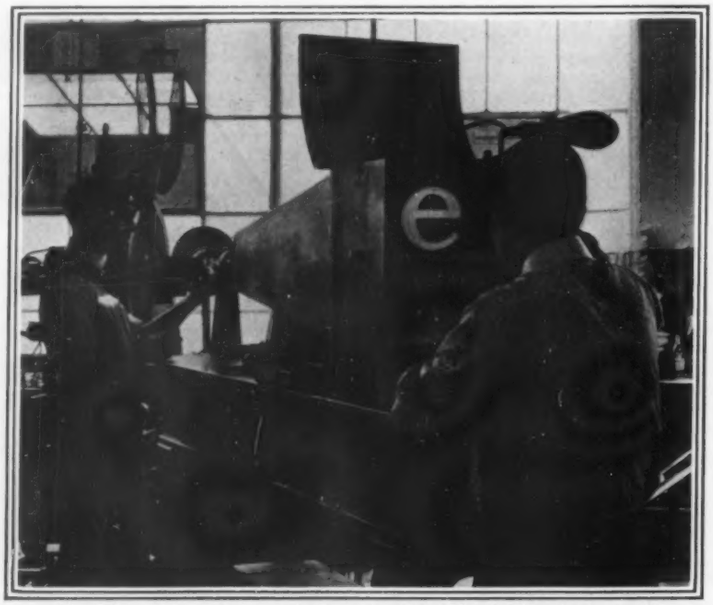
A close-up of the engraving machine on which the steel punch for producing the matrix is made

To illustrate the extreme delicacy of its work, one of the Benton machines in the punch-cutting department of the American Type Founders Co., Jersey City, has been used to reproduce a five-inch model of the Lord's Prayer to a space one-sixth of an inch square, difficult to read under a microscope.

Ultimately, this machine was adapted to cutting type-punches in steel as well as molds from which to make matrices, and it is used as a punch cutter in making matrices for type-setting machines.

After a new style of type has been carefully designed, a large brass model is made for each letter. Being several inches in size, it can be very accurately proportioned as to details. The operator of the punch-cutting machine follows the lines of the brass model, and the ingenious cutting tool above reproduces it with much greater accuracy than is possible in hand punch-cutting. Only one model of each letter is needed in making a series of type in different sizes, for by adjustment, the cutting tool reproduces the letter in any size desired, from bold display down to the tiniest type sizes that will print legibly.

Cutting the punches is only the first step in the long intricate process of making a type-setting machine matrix. Another ingenious machine takes the punch and stamps the matrix in a brass block, which then goes through more than fifty different operations to shape it for the rapid, delicate work of the type-setting machine. The passage of matrices through a linotype machine is so fast that it cannot be followed by the eye. The different letters to compose an average word are released by the operator's fingers in about one second. Each must fall into its proper place. After casting, which involves some heating, the matrices must automatically go back to their proper places in the magazine. To do their work accurately and stand up in service, they must be machined to watch-making tolerances. After each operation, as the intricately formed matrix emerges from the block, it is gaged and inspected. Not a single spot in its surface, nor any of its complex dimensions can be overlooked. The final inspection is made with an apparatus known as the "projectoscope," which magnifies the letter so that a type of the size used to print this article appears half the size of the inspector's head. The enlargement is so great that a variation of one-fifteenth of the thousandth part of an inch is immediately detected. That such a defect repeated on the printed page should be noticed by a reader is one of the wonders and mysteries of the human eye.



Final inspection of a matrix by magnifying in the "projectoscope"

Besides speeding up and cheapening the making of type punches, this machine is used for making trade-marks and other symbols formerly printed from electrotypes. The name of a product in a peculiar style of lettering, or a design used in branding goods, or even small illustrations, which were formerly made in quantity by the electrotype process, are now cut on a punch by the engraving machine, and used to make either a type or type-setting machine matrix. It can then be cast on a regular type body for a fraction the cost of electrotyping, and also fit accurately into a regular line of type where an electrotype would require justification.

Temperament and Bodily Constitution

IN the *Journal of Comparative Psychology* for December, 1921, Dr. F. S. Hammett of the Wistar Institute has an important article on "Temperament and Bodily Constitution." The article supports the theory of the reversibility of the reaction between bodily constitution and temperament. The author first distinguishes exogenous and endogenous stimuli. Organic differentiation, accompanying evolution, he says, gave rise to new sources of "endogenous" stimuli: these are distributed by the blood and apparently exert their effect through the mediation of the nervous system. Among the

later developments of this differentiation there arose certain gland-like colonies of cells which produce secretions that have an effect upon the manner in which the organism responds to *exogenous* stimuli, and hence on instinctive reactions. Such secretions are produced, for example, by the thyroid and the adrenals and may be collectively designated as the endocrine stimuli. It is with the appearance of these structures that evidence begins to accumulate of the new factor of temperament in animal behavior, and this leads us to relate temperament with the activity of the endocrine glands. We see then how instinctive reactions, at first relatively simple reflex responses, become more and more modified in expression, first by the development of the nervous system and then by the increasing differentiation of tissues, until they become strongly conditioned by endocrine activity.

The author therefore looks on temperament as largely the expression of the influence of the conditioning factors of the endogenous stimuli on instinctive behavior.

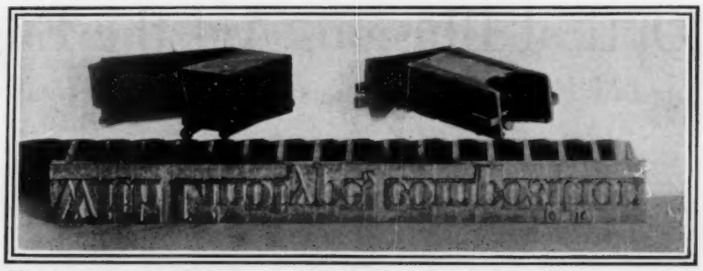
Two extremes of temperament are found, between which all gradations of behavior occur. There is a group of calm phlegmatic individuals with every evidence of a high threshold and a low irritability in their effective response to excitation; and there is a group of excitable persons of low threshold and high irritability, whose reactions are out of all proportion to the importance of the exciting cause. These differences in temperament seem to be associated with differences in the manner in which the respective individuals handle their intermediary metabolism. In the unemotional type the variability of the metabolism is low. In the excitable type the variability is relatively greater. Hence it is evident that as is one's temperament so is one's intermediary metabolism.

The author's studies extend the propositions developed by Cannon with respect to the effect of emotion on bodily constitution to include the idea that factors of endogenous origin which give rise to temperament in turn have their function affected by temperamental responses, so that the reaction "bodily constitution-temperament" is reversible.

The experimental demonstration of the profound influence of temperamental tone on bodily constitution is significant of the practical value of the regulation of the expression of temperament by voluntary action.

The Musical Typewriter—A Device for Transposing and Recording Music

THE knack of transposing music from one key to another is a difficult one to master, especially when playing the piano. To some it comes easier than to others, but it is a very necessary phase of music that cannot be overlooked. It has remained for Dr. Moritz Stoehr, Professor of Bacteriology at Mt. St. Vincent College, in New York, to invent a machine which we will call the musical typewriter, and which serves to transpose piano music and to make permanent records of the music being played.



Three steps in producing a matrix or mold: Upper left—Steel punch from which matrix is made. Upper right—Type-setting machine matrix. Below—Linotype slug

The musical typewriter is a combination of two instruments, one of which automatically transposes music from one key to another, while the other records by a series of dashes on rolls of paper the music which is being played. The transposing device consists of a portable keyboard of the conventional type, to be superimposed on the regular keyboard of a piano. The superimposed keyboard can be moved up or down on the piano for a range of two octaves. As our drawing shows, under each key of the keyboard is a lever, which presses upon the key of the piano directly beneath when the superimposed key is pressed. Thus, a musician may play a musical composition on the superimposed keyboard in but one key; but, by a simple adjustment of the transposing device, the composition may be played indirectly on the keyboard of the piano in any key whatsoever, whether a half-tone or six tones, lower or higher, than the key in which it was originally published. One of our photographs shows the scale at the upper end of the superimposed keyboard along which the keyboard is shifted laterally and which indicates the number of tones by which the composition is to be raised or lowered in pitch by the movement of the portable keyboard.

This invention will be valuable to voice teachers, whose pupils may be accompanied in any key which best suits their range, from a single edition of a composition; it will be valuable to the singer, who may with its help bring any composition within the range of his voice; and it will be valuable to accompanists, who are often confronted with the problem of transposing difficult accompaniments at sight, an undertaking which, contrary to popular belief, is always far from easy and with some compositions well-nigh impossible.

So much for the transposing device as it is used when superimposed on a regular piano keyboard. The other operation, that of recording music, may be performed quite apart from the piano, if desired. In fact, the composer may seat himself comfortably in his favorite armchair, place the portable keyboard in front of him, and play. Every note will be faithfully recorded by the typewriter-like mechanism placed in the middle of the removable keyboard. By referring again to our drawing it will be seen how the pressure upon a key of the superimposed keyboard, and indirectly upon the lever beneath it, is transmitted by means of a fine wire to a corresponding steel bar, or striker, which strikes upon the specially prepared paper as it passes over the inked roller. There are 88 of these little hammers or strikers, to correspond with the 88 keys of a conventional piano keyboard, compressed within a space of not over 15 inches. Each of these strikers is connected up with a key of the superimposed keyboard. The musical typewriter may also be shifted laterally, so that the music may be recorded in quite another key from that in which it is performed on the superimposed keyboard. For example, a composition may be played in the key of E flat on the portable keyboard, sounded in the key of C from the piano, and recorded in the key of B flat, if it is so desired. This utility will appeal to publishers who need music transposed and recorded in several keys; and it will appeal to composers who wish to have recorded the results of their improvisation. Many composers do their sketching at the piano; and in many cases ideas are lost by their inability to record the thought in its entirety before it is forgotten.

The third feature of importance of this remarkable invention is the specially prepared paper against which the little hammers strike. Instead of the music score to which we are accustomed, with its bass and treble clefs of five equally-distant lines each, the paper is divided from right to left by a red line which indicates middle C on the piano. Fine black lines are drawn to the right and left of this C line, arranged at such distances from one another that they form a skeleton for a continuous chromatic scale embracing the entire keyboard. In this manner all the notes may be read at will either as in the treble or the bass clef. Sharps and flats are dispensed with; for the line on which the hammer falls indicates the exact position of the note as played on the piano. The strikers are equally distant from each other; and as long as a note on the superimposed keyboard is depressed the corresponding hammer continues to leave a mark on the moving paper. With a little practice any musician will be able to determine at sight each note and its time-value, just as a painter can estimate proportions at a glance. The old system of rests is also eliminated; for the rests in Dr. Stoehr's system of notation are indicated clearly by the absence of note lines.

By substituting a special set of hammers the rolls of paper may be cut for use in player pianos.

That Dr. Stoehr's transposing and typewriting keyboard is of value is indicated by the interest which the Steinway organization has shown in it. In fact, it was Mr. Johnston, expert model maker of the Steinway shops, who made for Dr. Stoehr a miniature model of his invention which was exhibited to musicians recently assembled in New York from all over the country during Music Week. The invention is now on exhibition, and has been for several weeks, at Steinway Hall, New York, where it has been examined and approved by various musicians, including Wilhelm Hengelberg and Leopold Godowsky.

Left: Close-up view of the musical typewriter mechanism, showing the striker bars, paper roll, motor drive, and the keyboard. *Center:* The musical typewriter in position at the upper end of a piano keyboard for the transposition of a given piece of music. *Right:* Schematic details of the musical typewriter in position over a piano keyboard

The musical typewriter which makes possible the automatic transposing and recording of piano playing

When Optical Illusions Aid the Engineer

A Familiar Instance of False Appearances, and the Practical Use Made of It

By F. Rowlinson

EVERYONE has noticed at the movies the optical illusion whereby the wheels of an auto appear to turn backwards, while the auto itself is clearly going forward. The phenomenon is a special case of that "persistence of image" on which the whole movies depend. When, however, an object such as a revolving spoked wheel is presented, the illusion of motion is sometimes not perfect. If the wheel revolves at such a rate as to bring each spoke into the position occupied by another spoke in the preceding picture, the wheel will, of course, appear to stand still. If the distance moved is less than half the angular distance between the spokes, the wheel will appear to revolve normally, but if the distance is more than this, say three-quarters the angular distance between the spokes, then an illusion of backward motion is produced. The eye connects each spoke of the wheel with the spoke which, in the previous image, was nearest to its present position, although really this latter spoke has moved considerably from this position. If a wheel be prepared with spokes differing between themselves in shape or color, the eye cannot confound them, and no illusion is produced; the illusion happens only when the spokes are identical in shape and color.

"Stroboscopic vibrator" in use in testing an electrical machine. Since the camera is not to be deceived by the illusion, it has of course been necessary to bring the apparatus to a dead halt to show the appearance that meets the eye when the two rotations are at speeds bearing the desired relation

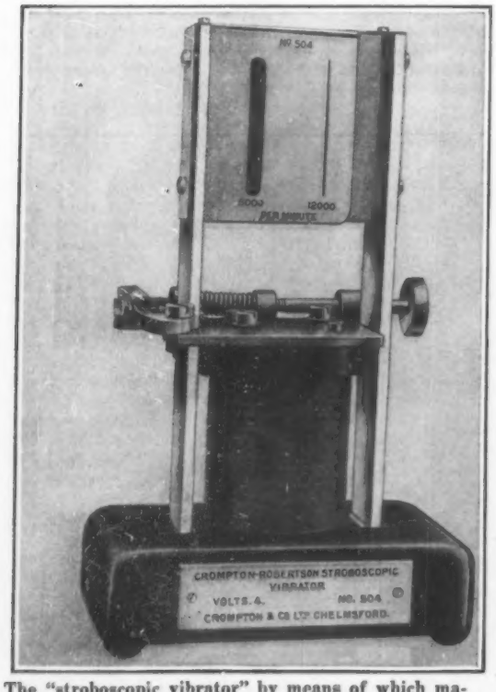
This "stroboscopic illusion" has been used by engineers in experimental laboratories for test purposes for a number of years. The apparatus has been somewhat too complicated, however, for general use outside the laboratory, notwithstanding certain important advantages offered by this method. The writer well remembers seeing it used, accidentally and in a crude form, when he was quite a youth. In a certain powerhouse there were two slow-speed engines of the old-fashioned type, driving large flywheel generators. It was necessary that these should run at the same speed as exactly as possible, and an old charge-hand hit on the ingenious plan of using a stroboscopic illusion to determine their synchronization. The lamps in the roof threw a shadow of the arms of one wheel across the arms of the other. When both engines were at work, nothing could be seen of the flywheel arms, but on taking up a position where it was possible to look through one revolving wheel at the other, a curious "shadow wheel" was always to be seen, with arms clearly defined. Sometimes the shadow wheel would slowly rotate clockwise or in the reverse direction, according to which of the two flywheels was revolving more quickly; sometimes it would move irregularly, making a sudden half-revolution or more. But when the two flywheels revolved at exactly the same speed, the shadow wheel remained perfectly stationary—thus affording a most convenient and accurate test of synchronization.

But apart from such crude rule-of-thumb applications and the complication of the laboratory instruments, there existed a necessity for a simple but scientific instrument useful to the works engineer. To meet this demand, Professor David Robertson of Bristol has invented the stroboscopic vibrator shown in the photograph. The apparatus consists of two similar vibrating bars clamped to a cast-iron base, on which is mounted an electromagnet and interrupter quite similar to those used in the ordinary electric bell. The electromagnet serves to start and maintain a rapid vibration of the two bars at any predetermined speed, depending upon the character and size of the bars themselves. The two bars carry aluminum wings, through slits in which vision is permitted at definite points of each cycle of vibration. The wide slit gives "edge" vision at the same rate of frequency as the vibration of the bars, the narrow slit gives "slit" vision at twice that frequency.

The instrument may be used in a number of ways. A beam of interrupted light, known as a "stroboscopic beam," may be passed through the vibrator on to a pattern marked on some revolving part of the machine to be examined, which is then viewed directly. This requires a generally reduced lighting, and it is usually better to view the well-lighted machine directly through the vibrator. The standard pattern-card contains seven rings, corresponding to the spoked wheels in our first movie example. The inner ring has drawn round it 15 "gothic" teeth, and the other rings progressively outward 16, 17, 18, 19, 20, and 80 teeth, although other arrangements may be used. The determination of the losses in an electrical machine by the retardation method may be taken as a typical use of the stroboscopic vibrator. The machine is started, run to speed, and allowed to slow down naturally. As the revolving pattern is viewed through the vibrator, the inmost ring will appear to slow down, become stationary and then glide backwards. At the instant it becomes stationary, the observer taps the key in his right hand, and the time is recorded by a chronograph to a fraction of a second. As the machine slows down further, the second ring of teeth will apparently come to a standstill, and reverse its direction of rotation, and so on for each ring successively. Besides the primary speeds at which each tooth moves forward exactly into the space occupied by the one in front, and the ring appears stationary, it is possible to distinguish quarter, third, and half primary speeds by the overlapping of the teeth of the ring. In this manner the operator quickly obtains most accurate data from which to calculate his test results. The same apparatus can obviously be used in a variety of ways which will suggest themselves to engineers—the observation and detection of cyclic irregularities, etc. The advantages of this optical instrument are that it covers the whole range of speeds from the highest to the lowest with perfect accuracy, it consumes no power from the machine to be tested (important in small machines), and it has no inertia and can therefore indicate the most minute variations of speed, even if these be only momentary.

Another recent and most valuable application of the stroboscopic principle to the service of the engineer is the Elverson "oscilloscope." This is a practical device which may be termed an optical gear-ratio. The gear box of the instrument is connected with a suitable shaft on the machine to be observed, which is then run in a subdued light. The gear box contains a mechanism resembling the contact-breaker of an ordinary magneto, except that the circuit is *made* at a given

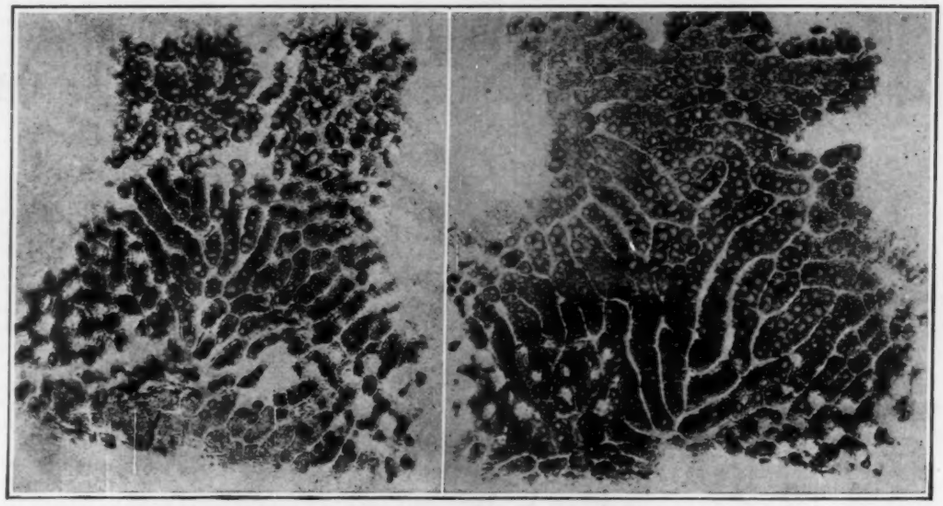
(Continued on page 367)



The "stroboscopic vibrator" by means of which machinery rotating at high speed is examined as though the speed were low, without any of the characteristic effects of the high speed

The Elverson oscillograph, showing the hand-lamp that gives the flashes, and the gear-box to give "stationary" or "creeping" vision of high-speed machinery in action

Taking Bossie's Nose-Print



Two typical nose-prints of cows, showing how readily the identification may be established with this record

FINGER-PRINT identification of criminals and suspects has been in use for more than twenty years. It has taken a long time for anyone to think of applying the principle to the identification of dairy cows. This, however, is now being worked out with every prospect of success in the Division of Dairy Husbandry at the University of Minnesota. The cow's nose is traversed by innumerable ridges similar to those of the human hand, and from the patterns of these a solution has been indicated of the problem of positively identifying individual cows.

This has always been a very real difficulty. In registering and selling high-priced animals, and in conducting official milk tests over a period of several months, the greatest care must be taken against intentional or accidental substitution of animals. With the broken-colored breeds like the Holsteins and Guernseys, a sketch of the markings is required, but it is found that many farmers are unable to make a sufficiently accurate drawing to avoid dispute when the question of identity arises. In the solid-colored breeds like the Jerseys the situation is even worse; tattoo marks may always be imitated, and two-thirds of the Jersey cattle answer to the official description "solid color, black tongue, black switch." With unregistered breeds the owner's word must be taken without reserve for the animal's identity. Even when there is no intent to deceive, mistakes of identity, it is believed, are frequent.

Experiments in taking and classifying nose-prints were begun in October, 1921. As with finger-prints, two important points must be considered. Is the cow's nose-print different from that of every other cow? And does the pattern remain the same at all ages? As with the human finger, both these questions must be answered in the affirmative before the nose-print will be of value in identification.

The prints of more than 350 animals have been taken and carefully scrutinized. So far no two have been found even sufficiently alike to cause any uncertainty as to their being from different animals. And both growing calves and older animals have been nose-printed for five consecutive months without indicating any change of design. A careful study of the prints indicates that while there is enlargement of the nose, the arrangement of the ridges remains fixed.

It is simple and easy to take the prints and to instruct others in doing so, by mail. One man does the trick, holding the cow's head under his arm and working with his free hand. The nose is wiped dry with a flannel cloth, because the cow sweats freely through the nose. A common stamping pad is then rubbed back and forth or pressed against the nose until the ridges are well inked. Then the print is taken by pressing firmly against the inked nose a sheet of soft paper fastened to a board, beginning with the lower edge of the paper, at the base of the upper lip, and rolling upward toward the face. Ordinary black stamping-pad ink is the most satisfactory, with printers' or mimeograph ink a second choice.

The system is being given a practical test in connection with various official tests in Minnesota. Already its value has been manifest, and it has straightened out several cases of disputed or mistaken identity. Perhaps its greatest value will be to the live-stock insurance companies. All these concerns claim that they have paid many claims where they suspected but could not prove that the policy covered some other animal than the dead one. With a system of nose-print identification, such false claims could be detected and proved.—*By Charles F. Collison.*

The Benefits of Research in Agriculture

THE benefits of agricultural research are so well known that it is hardly necessary to mention them. For example: A farmer produced pork at a cost of 44 cents per pound until he made use of information gained from research and then he reduced his cost 4 cents per pound. Through instruction based upon research and widely disseminated to the farmers, one State has shown how to reduce losses from the Hessian fly to the extent of twenty million bushels of wheat in four years, and all this at only a nominal expense. Research has made it possible to continue growing important crops in sections of the country where some pest or disease was turning the farmers' efforts to naught. About ten years ago the United States Senate showed that scientific research in the Department of Agriculture, costing about five million dollars annually, had resulted in saving about five hundred million dollars annually.

Books could be filled with interesting stories such as how the cause of wheat rust was discovered and a remedy applied, and how Texas cattle fever was placed under control and is being surely eradicated, and many other similar exploits. Add to all this the development of improvements of animals and plants and of agricultural methods generally.

Research is the foundation of our whole system of agricultural education in colleges and schools, through the Extension Service, and through agricultural journals and books. It also is the basis for regulatory laws, and for their enforcement.

It would be impossible to tell what would be the situation in this country if agricultural research had not been maintained. We know some of the most important improved varieties of plants and some of the better strains of animals would be missing. Some diseases of animals and food plants would be rampant. Great areas of soil now producing crops would be barren, and the production from still larger areas would be lowered. Farmers would be paying more for their supplies and some highly effective marketing methods would not be known.—*Abstract from address by R. A. Pearson, President's Conference on the Agricultural Situation, Washington, D. C., January 26, 1922.*

Checking Up the X-Ray with the Half-Tone Screen

OPTICAL delusions will sometimes occur in the case of contrast effects, a given portion of a picture appearing, though not actually being, lighter or darker than its surroundings.

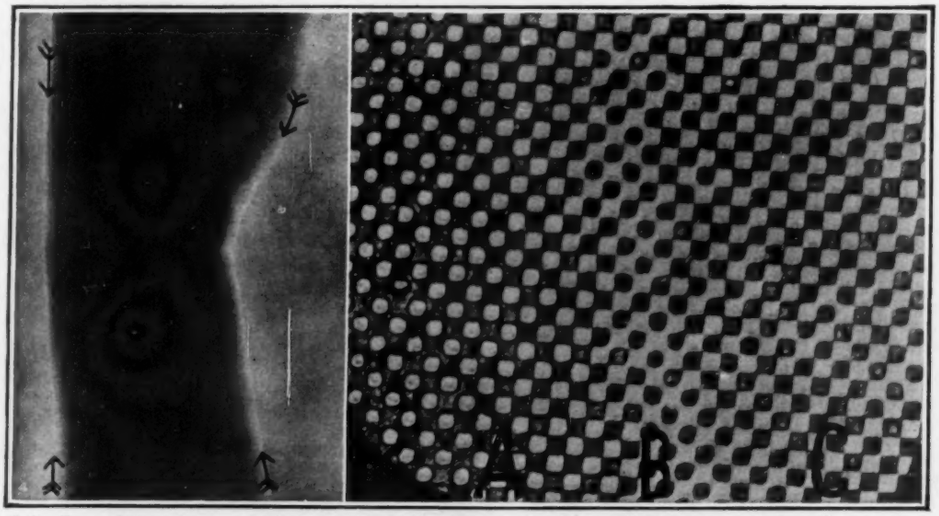
An interesting case in point recently occurred to the well-known pioneer in X-ray work, Prof. Alban Köhler, of Wiesbaden, when the actual existence or otherwise of some bright lines running along the right- and left-hand edges of the shaded portion in the Roentgen diagram of a wrist-joint, shown in the first of the two accompanying photographs, had to be ascertained.

Inasmuch as an inspection of the original plate through the microscope, with feeble magnification, would have been subject to the same sort of delusion as on examination with the naked eye, while a strong magnification of the photographic layer would have failed to supply any reliable data on the sizes of irregularly arranged silver particles, Prof. Köhler devised a new method which may even prove useful in testing other cases of optical delusion.

Half-tones, as is well known, are made up of a network of uniformly black minute patches of variable sizes, arranged at variable distances apart, the naked eye, at some distance, receiving the impression of continually graduated shadings. In order to prepare a half-tone, the picture in question is photographed through a fine grating traced on glass.

It now occurred to Prof. Köhler that the reality or otherwise of dark or bright lines, suspected of being optical delusions, could be ascertained by converting the picture into a half-tone and examining this with a feeble magnification. He therefore had an excellent reduction of the X-ray diagram in question printed as half-tone on high-grade smooth cardboard. Then he examined the cardboard print with a 30-odd magnification, obtaining the results shown in the second photograph. As seen from the picture, the portions corresponding to the bright lines were found actually to be constituted by smaller dark spots and accordingly to be endowed with reality.

This, of course, does not say anything about the nature and origin of the phenomenon. It may be mentioned that Einstein, in the *Memoirs* of the German Physical Society, in 1918, published a little paper where the probability was suggested of the phenomenon being due to total reflection of X-rays. Janus, even more recently, on the other hand, made some experiments showing the probability of the phenomenon being due to some photographic solarization process. Perhaps both these hypotheses are true, to some extent.



Left: X-ray photograph of wrist joint. Note the bright lines along the edges. *Right:* The X-ray photograph having been made into a half-tone, it is magnified about thirty times as shown here, when the actual existence of the bright lines becomes apparent by the smaller size of the dark spots above *B*

How the confusing details of an X-ray photograph can be checked up by means of the half-tone screen

Post-War Artillery

Developments in Large and Small Guns Since the Warring Days of 1918

By Major General *C. C. Williams*
Chief of Ordnance, U. S. A.

THE SIGNING of the armistice at the end of the World War brought to a close what was, from many points of view, the most stupendous conflict the world has ever known. The most notable factor developed by this struggle was the enormously increased importance of material as compared with previous wars. The World War, however, cannot be considered as overstressing the importance of material equipment in a major conflict. It leads us to the conclusion, indeed, that in great wars of the future materials and mechanics will be utilized to the maximum in conserving the man power of the nations and in speedily ending hostilities.

This development of the material side of warfare is well illustrated by a comparison between the cost of the ordnance equipment of General Rosecrans's army during the Civil War (which consisted of approximately 22,000 men) and the cost of similar equipment for a United States division, together with its pro rata share of corps and army troops during the World War (approximately 40,000 men). These figures are $645,000 and $6,757,000, or in terms of cost per man $29.30 and $164.37. Thus in the last sixty years the cost of ordnance material used by an army has increased over 500 per cent. This shows the costliness of applying to warfare the industrial and commercial progress of the world.

The new 155 M/M (6-inch) gun motor carriage affords remarkable cross-country mobility, with speeds up to 14 miles per hour on good roads

The artillery equipment which accompanies an army in the field is one of its chief supporting auxiliaries. Artillery fire screens the infantry advance and, simultaneously, neutralizes the fire of opposing artillery and machine guns, thus increasing the effectiveness of infantry and reducing their losses. As a vital contributory factor to the success of an army the artillery equipment should be the best possible; it should have the maximum obtainable ranges; the most accurate, powerful and effective ammunition; and the maximum of mobility to insure prompt delivery, where needed, of effective supporting fire. It should be capable of quickly vacating positions subjected to the destructive fire of the enemy.

To provide the Army of the United States with this perfected artillery equipment of high quality is a function of the Ordnance Department. The design, development, and test of this material is carried on in collaboration with the Artillery Services of the Army and in cooperation, to the fullest possible extent, with the engineering and manufacturing skill of the country; to the end that the final product may adequately fulfill the needs of the artillery and incorporate the latest commercial developments in design and productivity.

In all matters pertaining to ordnance the Ordnance Department is assiduously endeavoring to maintain those close contacts with commercial industry developed during the recent war. It is considered that such mutual understanding and cooperation in the solution of ordnance problems is indispensable to the practical development of our special ordnance material. That similar views are entertained quite generally by leading manufacturers, business men and engineers of the country is evidenced by the interest displayed in the activities of the Army Ordnance Association. This association, fostered by prominent civilians, was formed some time after the close of the World War and has for its object the perpetuation of contact and the cooperation of commercial industry with ordnance. The magazine of the association, known as the "Army Ordnance," provides a medium for the dissemination of ordnance data and the interchange of views and ideas.

Immediately following the war a board of officers known as the "Caliber Board" or "Westervelt Board" was convened by the War Department with instructions to make detail studies of the artillery equipment pertaining to a field army, including types, calibers, kinds and proportions of ammunition and methods of transport. The report of this Board of Officers has served as a general basis for the post-war development of artillery. The board generally recommended greatly improved artillery equipment as both desirable and necessary.

GENERAL WILLIAMS, the author of this article, accompanied General Pershing to France in May, 1917, as Chief Ordnance Officer of the American Expeditionary Forces. After serving in that capacity for about a year, he returned to Washington, D. C., to become the Chief of Ordnance. Subsequently to the Armistice, the General and his very able staff have developed a series of service guns of various calibers which in range, power, mobility and light weight mark a truly amazing advance over the best artillery used by the combatants at the close of the war.—THE EDITOR.

The requirements for artillery to accompany a field army specify increased range, increased power, and increased mobility, without material increase in weight for all types of mobile artillery. It was the opinion of the members of the board that none of the existing types of mobile artillery material were entirely suitable and that greatly improved divisional, corps, and army types should be developed. To standardize manufacture and facilitate maintenance in the field, it was recommended that but one carriage be provided for each of the divisional, corps and army types, and that this carriage mount either the gun or its corresponding howitzer.

In an effort to produce the light or divisional artillery to meet the recommendations of the Westervelt Program, three types of carriages have been built. The problem was to incorporate the lessons of the war as regards mobility, light weight and flexibility without sacrificing any of the desirable features in present carriages that gave satisfactory service. Such features as the split trail, where it could be used within the weight considerations, hydro-pneumatic recoil systems with variable recoil, axle traverse, and the use of equilibrators to balance the tipping parts have been introduced in these new experimental types. In addition to the above features a single carriage was designed to mount either the gun or its accompanying howitzer.

The three new experimental types are the 75 M/M gun—105 M/M howitzer carriage, model 1920; the 75 M/M gun carriage, model 1921, and the 105 M/M howitzer carriage, model 1921. The model 1920 carriage of the split trail type was designed to mount either the 75 M/M gun or the 105 M/M howitzer. By using the split trail it is possible to secure a maximum traverse of 30 degrees and a maximum elevation of 80 degrees—two very desirable characteristics for field artillery fire. The carriage, because of its rather complicated construction, is heavier than the French 75, having a total weight of 3670 pounds. Four of these 1920 carriages have been built and are now at the Aberdeen Proving Ground, Maryland, for firing and road tests. Two of them will be sent to the field artillery for service test in the near future.

This is the new 4.7-inch gun in firing position. The gun fires a 45-pound projectile to a maximum range of nearly 12 miles. Note the split trail which permits of 60 degrees of traverse

The 75 M/M gun carriage, model 1921, is of the box-trail type. Its outstanding characteristic is its light weight for the power of the gun. This carriage weighs about 1000 pounds less than the 1920 model, with the same range. In order to secure this light weight, nickel steel plates and rivets were used. The box trail gives only 10 degrees traverse as against 30 for the 1920 carriage, but with the light construction the low weight at the end of the trail permits of ready traverse by one man, thus compensating for the wide traverse secured with the split trail. The maximum elevation of the gun on this carriage is 52½ degrees, which is more than is required for maximum range.

The 105 M/M howitzer carriage, model 1921, is similar in design to the 75 M/M gun carriage, model 1921. The effort was made in this design to secure the minimum weight consistent with the strength necessary to withstand the firing and traveling stresses. Nickel steel plates and rivets were used throughout, and the total weight of 2970 pounds has been ob-

tained for this carriage. The total traverse of the howitzer on this carriage is 8 degrees and the maximum angle of elevation is 52½ degrees. A feature of the carriage is the constant length of recoil, and due to its particular mounting the howitzer, during recoil, clears the ground up to 35 degrees elevation.

The maximum range of this newly-developed divisional gun is 15,000 yards and for the new howitzer 12,000 yards. The range of this new 75 M/M gun exceeds the range of this caliber of gun used in the World War by several thousand yards.

The development of corps artillery in conformity with the recommendations of the Westervelt Board has resulted in the construction of an experimental type of carriage which mounts, interchangeably, the 4.7-inch gun or the 150 M/M howitzer on the same recuperator. Due to the difference in power of the gun and howitzer it is necessary to adjust the recoil mechanism to give the proper recoil for each. This carriage is of the split trail construction, permitting a total traverse of 60 degrees of the gun on its carriage and a maximum elevation of 65 degrees. The weight of the carriage with either the 4.7-inch gun or the 155 M/M howitzer is approximately 13,000 pounds. The maximum range of the gun is in excess of 20,000 yards, and of the howitzer about 16,000 yards.

As the weight of this carriage exceeds the allowance of 12,000 pounds for a single load for corps artillery, it has been necessary to design a special wagon for transporting the gun when this material has to be moved any great distance. The task of transferring the gun from its firing carriage to its transport wagon or vice versa has been so developed that it is quite a simple operation, requiring but a few minutes' time. In the effort, however, to obtain a single unit complying with the weight limitation, a 4.7-inch gun carriage, model 1921, has been designed and built. This carriage, which mounts only the 4.7-inch gun, is within the weight limitation for a single load.

The newly-developed Army artillery carriage, mounting the long-range 155 M/M gun or the powerful 8-inch howitzer, is of the split-trail type, permitting a maximum traverse of the gun on its carriage of 60 degrees and a maximum elevation of 65 degrees. The recoil mechanism is of the hydro-pneumatic type, providing variable length of recoil.

The maximum range of this gun with a 95-pound projectile is more than 14½ miles. The maximum range of the 8-inch howitzer mounted on this carriage, firing a 200-pound projectile, is more than 10½ miles. These ranges are approximately four miles greater than those obtained with similar calibers of artillery during the World War.

The increase in range for the new mobile artillery has been accomplished by using higher muzzle velocity and by increasing the efficacy of the ammunition. The higher muzzle velocities in turn have been obtained by the use of longer guns, thus permitting the maximum powder pressures to remain approximately the same.

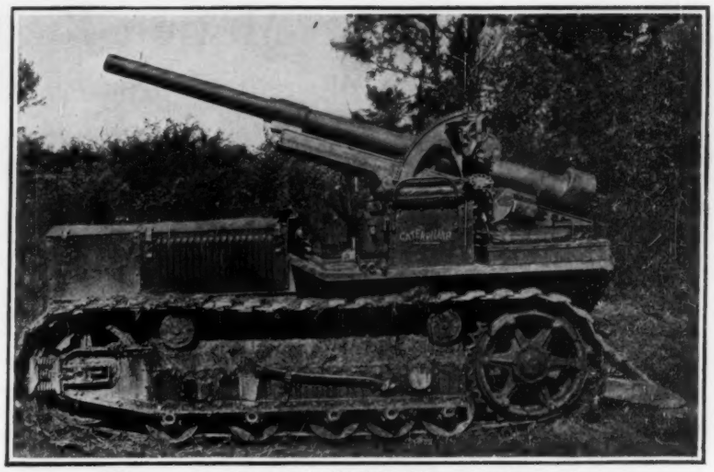
The mobility of field artillery is a difficult problem, always requiring the most careful consideration. This is especially true of the 75 M/M gun for the divisional artillery, which must be suitable for the draft of a six-horse team. The constant demand, during the recent war and since, has been for greatly increased mobility of artillery, not only for higher speeds on the roads but also for artillery capable of maneuvering across country independently of the roads. All new types of wheeled gun carriages have, therefore, been provided with rubber tires to permit of their being towed at higher rates of speed without serious injury to the carriage. To accomplish this desired degree of mobility, special high-speed tractors have been designed and developed of 3, 7 and 15 tons capacity to draw the materials of the divisional, corps, and army types.

The conventional wheeled gun carriages and particularly those of the larger types are generally restricted to the roads or fairly hard ground when maneuvering off the road. The degree of mobility which requires gun carriages to cross rough, difficult, and often swampy terrain has brought about a very promising new development in the form of a self-propelled gun mount or motor carriage. The motor carriage is essentially a high-speed tractor on which a gun is permanently mounted, so that this new development meets the combined requirements for increased speeds on the roads and the ability to maneuver independently of the roads. The motor carriage developments have followed along the lines of both the conventional caterpillar tractor and the combined wheel- and track-laying vehicle.

Divisional and army motor carriages of both types have been constructed and are now undergoing test. Normal track speeds of approximately 12 miles per hour are prescribed for these motor carriages, although it is hoped eventually to obtain speeds of more than 20 miles per hour for the divisional motor-car carriage. The indications are that the motor carriage presents a very promising field of new development for mobile artillery. Contemporaneously with this extensive development of mobile artillery to accompany a field army, the seacoast artillery has been perfected to a very equipment has been Military authorities remarkable extent. ceded that battle have generally con-successfully attack ships cannot hope to equipped with land fortifications this briefly estab- equal armament, and for seacoast fortifi- lishes the requirements cations equipment. The 16-inch 50-caliber gun and the 16-inch howitzer are now the standard armament for long- range coast artillery.

Until a few years ago the guns on the first-class battle ships of the leading nations of the world were capable of not more than 20 degrees' elevation. The newer battleships, however, are equipped with guns having 40 degrees' elevation with corresponding ly longer ranges. This change in the arma- ment of the modern navies of the world has necessitated more powerful seacoast defense artillery.

The Ordnance Department of the United States Army has recently developed, tested, and is now providing for the im- portant coast defenses of the United States, 16-inch 50-caliber guns, mounted on bar- bette carriages, which will out range the guns now mounted on any battleships. This carriage has 360 degrees' traverse and a maximum elevation of 65 degrees. As weapons of this character require some three years for construction, it is necessary that they be manufactured and installed in time of peace if they are to be available in time of war.



The new American 75 M/M (3-inch) gun motor carriage

The 16-inch 200-ton coast defense rifle. Powder charge of 850 pounds throws projectile of 2340 pounds to extreme range of 50,000 yards

A more detailed description of this powerful weapon, I believe, will be of interest. The 16-inch gun, of wire-wrapped construction, is approximately 70 feet long, and with its recoil band weighs approximately 200 tons. The powder charge for one round consists of 850 pounds of smokeless powder, which produces a maximum powder pressure in the gun of 38,000 pounds per square inch. The projectile, weighing 2340 pounds, can be hurled to a maximum range of over 50,000 yards, and its armor-piercing qualities gives it a penetration of more than 14 inches of the best armor plate at all ranges.

To handle this 2340-pound projectile and its 850-pound powder charge, at the high rate of fire of one shot per minute, a power rammer has been provided on the racer near the breech of the gun. This power rammer is electrically driven, connected through a hydraulic speed gear, to insure accurate and positive control. The projectiles and powder are brought up to the loading tables on the carriage in special cars operating on standard-gage tracks.

The breech block on the 16-inch gun is opened and closed by compressed air, supplied by an air compressor located on the mount. As a safety precaution the operation of opening the breech block introduces a charge of compressed air into the bore of the gun sufficient to remove all powder gases, thus preventing the hot gases in the bore from blowing to the rear and injuring the operating personnel or possibly igniting the powder charges on the nearby powder cars.

All the movements involved in the operation of the gun can be manually performed if necessary.

It is quite impossible in this brief review to do more than present a general picture of this extensive program for the development of special artillery material being conducted by the Ordnance Department. The work takes a great amount of time, but vast economy results from carrying on this experimental and development work in time of peace rather than postponing it until after the actual outbreak of an emergency.

Tests made of the new materials indicate generally their satisfactoriness in their major characteristics; but the perfection of details and modifications to facilitate quantity production will still require years of research work. It is the policy of the Ordnance Department to maintain designs of ordnance material at least the equal of the best known in the world, and to concentrate upon the thorough test of all new developments, so that there will be available in case of an emergency complete drawings and manufacturing specifications of thoroughly practical and tested designs adapted to quantity production.

The new 155 M/M (6-inch) gun fires a 95-pound projectile to a maximum range of nearly 15 miles

Motor Cars on the Farm

ACCORDING to figures recently made public by the Census Bureau, more than 30 per cent of the farms in this country now have motor vehicles. The total number of cars on the farms is given as 2,146,512, a little less than a quarter of the total for the country. Canadian registration figures published recently show that the farmers of Ontario own 36.8 per cent of all the automobiles in that province. And near Winnipeg there has been found a grain farm of 12,000 acres upon which not a single horse is used, nor a single head of livestock raised. All the work is done with trucks and tractors. It was figured that 400 horses would be necessary to do all the work on the farm and 2000 acres would be required to feed them.

Motion Pictures by Radio

The Promise of "Movie" Broadcasts, with Receiving Stations in Every Home

By C. H. Claudy

IN SPITE of the startling character of the idea conveyed in the title, it should not be any more difficult to conceive of the translation of electrical wave-impulses into pictures, if such waves have picture characteristics impressed upon them, than to understand the translation of electrical wave-impulses into speech, music, voice, orchestra sounds, if such waves have such characteristics impressed upon them.

A new tool is invented for the scientist. Inventors promptly begin using it in ways its originator never dreamed about. That his tube would open the way to a new theory of matter was never dreamed of by Crookes; that the electric magnet would one day make a telephone was never thought of by Henry; that the audion would be what it is in telegraphy, telephony and wireless would hardly have been envisioned by De Forest; and certainly the prism-ring, or ring-prism developed by Jenkins to form a continuous, instead of an intermittent, motion-picture projector was never imagined by him to be the missing link in the tool chest which would make pictures by wireless possible.

In this case, however, it is the originator of the tool who also finds the new use for it, and it is in the laboratory of C. Francis Jenkins in Washington, D. C., that one can see pictures sent by wireless and get a glimpse of the experiments by which he confidently expects to send motion pictures by a broadcasting process, much as concerts are broadcasted today.

Readers of the SCIENTIFIC AMERICAN will recall (issue of April 9, 1921) the ring reversing-prisms which make the high-speed camera for motion analysis possible. The best of the mechanical, stop-motion instruments can slow up nature eight times. The ring-prism camera slows up motion a hundred, two hundred, a thousand times—there seems to be no limit except desirability. Already this curious device, which many opticians said was "an impossible shape," has slowed up the shell entering armor plate so that its picture image on the screen wriggles and crawls into the steel.

It is this same curious optical device which, combined with other scientific devices already in the armory of the scientists, make picture sending via radio possible.

The apparatus, from the sending end, includes, in addition to the usual wireless apparatus, a pair of prismatic rings, and a light-sensitive selenium cell. The function of the prism rings is to make a spot of light, projected from the picture to be sent, upon the light sensitive cell. This spot of light travels across and across and across the surface of the picture and each journey is its own width below the path of the previous journey. In one complete revolution of the slow-moving ring-prism, and one hundred revolutions of the fast-moving ring-prism, the picture has been completely covered with a moving spot of light, which varies in strength according to the lights and shadows of the picture. The selenium cell translates these variations in light-strength into variations in current-strength, and these variations are transmitted by wire or wireless, indifferently.

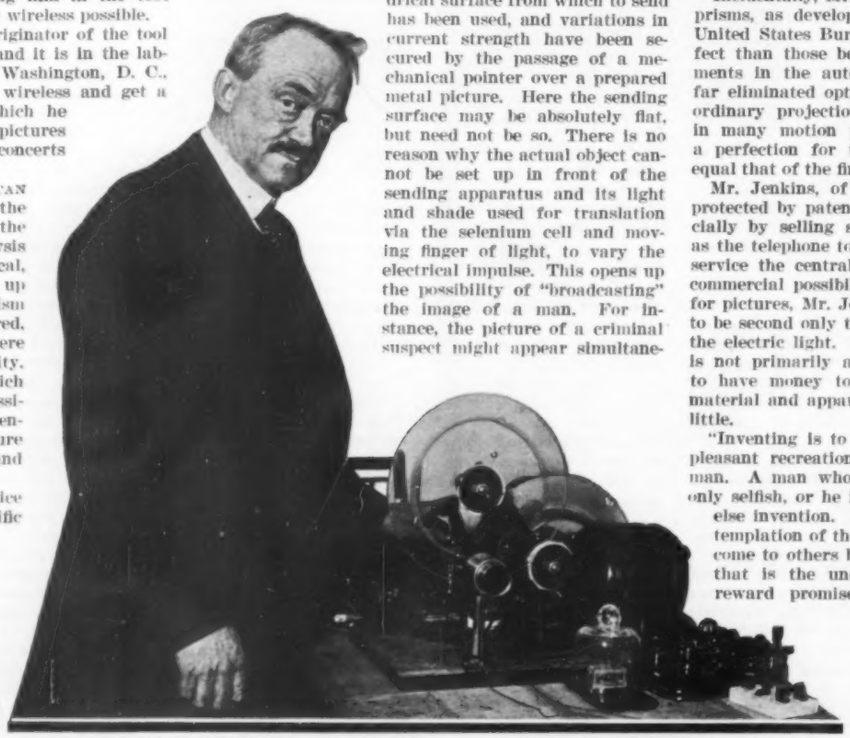
The receiving apparatus includes a pair of the ring-prisms, running by motor in synchronism (approximately) with the sending prisms, and a simple light-valve—in practice, a tube containing bisulfide of carbon surrounded by a helix. Variations in electric impulse in the helix make the tube of solution more or less able to transmit light.

The variable and light-varied electric impulse is made to enter the light-valve, where the values of the incoming radio impulse are translated into variations in light-transmitting ability of the carbon-bisulfide-filled tube. The spot of light thus produced is made to move across and across and across a sensitive screen (ordinary dry plate), each passage from left to right being the width of the spot below the previous one.

It is obvious that if the two spots of light—sending and receiving—can be made to travel simultaneously, and if the strength of the first governs the strength of the second, the image which altered the strength of the first will be impressed by the variations in the strength of the second. Experimental proof has shown that complete synchronism between the receiving and sending sets is not essential; but practically perfect synchronism is most easily obtained.

The whole receiving apparatus is analogous to the use of a pencil point in the hands of an artist who chooses to draw a picture by drawing straight and parallel lines, close together, and who secures lights and shadows by pressing lightly or heavily on his pencil as he draws. In this case a pencil of light is used and its "heaviness" or "lightness" is not a matter of physical pressure but of brightness or dullness, which, in a given time, more or less impresses itself upon a photographic plate.

It should be noted that in all the other systems of transmitting pictures electrically, a curved or cylindrical surface from which to send has been used, and variations in current strength have been secured by the passage of a mechanical pointer over a prepared metal picture. Here the sending surface may be absolutely flat, but need not be so. There is no reason why the actual object cannot be set up in front of the sending apparatus and its light and shade used for translation via the selenium cell and moving finger of light, to vary the electrical impulse. This opens up the possibility of "broadcasting" the image of a man. For instance, the picture of a criminal suspect might appear simultaneously in a thousand police headquarters for identification.



C. Francis Jenkins and the ring-prism that seems to make possible the radio broadcasting of motion pictures

From the sending of a single or a still picture, by electrical impulse, either over a wire or via radio, to the sending of motion pictures in the same way is but a step. The moving picture camera does not make pictures which move; it makes a large number of still pictures, one after the other, in a short time. The eye upon the screen sees no movement; it sees but a succession of still pictures, different each from each by the result of movement. It is the brain, not the eye, that gets the impression of movement from the movie-screen. And if one picture can be sent via electrical impulse, so can many. It is merely a matter of sending them rapidly enough.

In the mechanical systems of translating pictures into electrical impulses there interposes the difficulty of preparing the many curved plates necessary. In this system, which uses the original object itself as the starting point for light variation, which is to be translated into electrical-impulse variations, there is no such difficulty. With light and electricity both moving at velocities of 186,000 miles per second, the capacities of neither projection nor receiving apparatus would be even touched by the broadcasting of sixteen pictures per second (ordinary movie projection speed). Mr. Jenkins foresees the broadcasting of moving pictures, either from the original happening itself, or from one original film, and thus the doing away with delays, with the immense expense of film exchanges and with the physical transportation of films.

Moreover, it is obvious that as we already have broadcasting of concerts and opera, there is no reason why we should not, with the new service, broadcast an entire theatrical or operatic performance, so that, instead of going to a movie house for an evening's entertainment, we can turn a switch and see the latest play and hear it spoken at the same time, or, by tuning *out* the play and *in* the concert watch the operatic singer as well as hear her.

Revolutionary as the idea may seem, it has been demonstrated. Indeed, as Mr. Jenkins points out, there is nothing new in the conception except the use of the tools already in existence, and designed for one purpose, here being used for a different purpose.

Incidentally, Mr. Jenkins explains that the first ring-prisms, as developed by him in conjunction with the United States Bureau of Standards, were far less perfect than those being made today; and that improvements in the automatic grinding machinery have so far eliminated optical error that they are today doing ordinary projection work equal to that accomplished in many motion picture theaters. He also predicts a perfection for this new tool of optics which will equal that of the finest telescopic and microscopic lenses.

Mr. Jenkins, of course, has his whole system well protected by patents and intends to use them commercially by selling service, rather than apparatus, just as the telephone today is not sold, but rented with the service the central station supplies. Asked as to the commercial possibilities of such a broadcasting system for pictures, Mr. Jenkins said that they seemed to him to be second only to such utilities as the telephone and the electric light. But, he added, "An invention to me is not primarily a means of making money. I have to have money to live on, and money to spend for material and apparatus, but beyond that wealth means little.

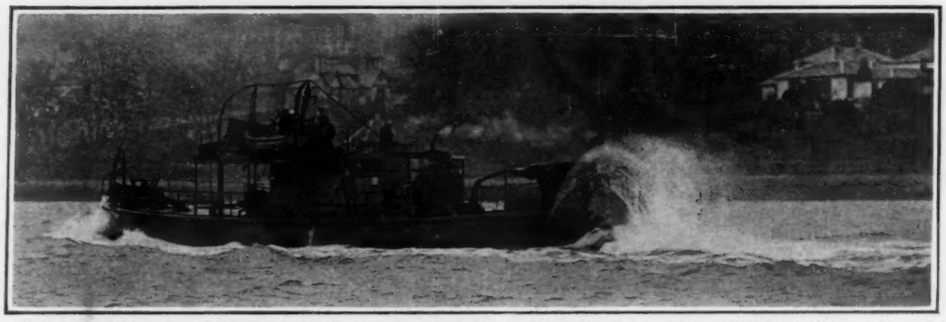
"Inventing is to me a very satisfying occupation, a pleasant recreation that equally benefits one's fellowman. A man who makes secrecy his greatest aim is only selfish, or he is fraudulently developing someone's else invention. I find the most pleasure in the contemplation of the comforts and enjoyment which will come to others by reason of my work. Incidentally, that is the underlying idea of patent law. The reward promised is intended only to encourage the inventor to work for the ultimate public benefit. Of course, I must make some money out of it; that is, I must make inventing pay or I could not go on. Beyond that I care little. The accumulation of great wealth does not seem to me an ambition which promises very great happiness."

International Union of Scientific Radio Telegraphy

THE International Union of Scientific Radio Telegraphy was organized two years ago for the purpose of furthering through international cooperation the systematic study of fundamental problems of radio communication. Separate sections have been formed for a number of different countries, and the work of the American section has been in progress for over a year. Recently systematic measurements have been made at receiving stations in the United States of the intensity of signals received from several French stations, and by a continuance of these measurements it is expected that more comprehensive knowledge will be obtained of the phenomena of radio transmission.

A meeting of the American section was held very recently at which the various committees reported, including committees on the study of radio wave intensity, atmospheric disturbances, variations of radio wave direction, measurements of radiations which cause interference, and electron tubes. Particularly in the case of the measurements of the intensity of radio waves, it is important that international cooperation be promoted, since it is only by frequent simultaneous measurements that accurate results may be had.

Vane-Wheel Proplusion of Ships



This vessel is being driven at nine knots by vane wheels, carried at the stern. This installation showed a 40 per cent economy as compared with the small, fully immersed screws with which the vessel was originally equipped

VANE-WHEELS are partly immersed propeller wheels whose axes are above water and lie substantially parallel with the keel of the vessel. They are fitted with propelling vanes, or plates, over that portion of the circumference which enters the water, and the vanes are given such a pitch that when the wheels are rotated they exert a forward thrust on the vessel.

It is a mistake to suppose that vane-wheels are suitable only for shallow-draft vessels; for William Denny & Bros., the well-known shipbuilders, to whom we are indebted for the accompanying illustrations, have proved the practicability of these wheels in smooth or partially smooth water; and the results so far obtained are such that they state their belief that vane-wheels are suitable for any draft, and may be due to replace any known form of mechanical propulsion. The vessels shown in our photographs were designed for ordinary twin-screws, and the vane-wheels were fitted without any covering answering to a paddle box—this with a view to a clear observation of the action of the wheels. In the case of a new ship designed especially to carry these wheels, a proper enclosure would be designed, as shown in the accompanying illustration.

In order to avoid bad steering effects, two vane-wheels must be used and placed symmetrically in relation to the hull of the ship, the pitch of one wheel being right-handed, and the other left-handed. Hitherto, the experiments with this type of wheel have been carried out in smooth water, and their availability in rough seas has yet to be proved. At the same time the substitution of vane-wheels for twin-screws, in the case of a full-size ship of such draft, speed, and power, in place of the submerged twin-screws first adopted, resulted in the surprising reduction of about 40 per cent in the power for the same speed.

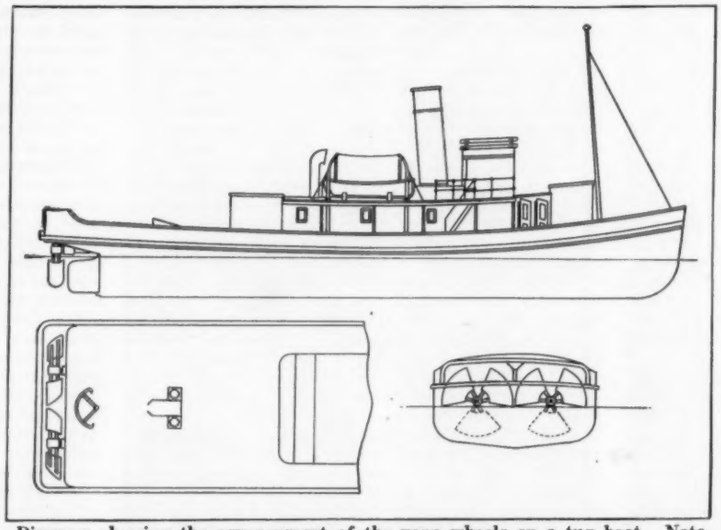


Diagram showing the arrangement of the vane wheels on a tug boat. Note that only the driving portion of the wheels enters the water

Hitherto, when the draft of a vessel has been so very limited as to involve a low propeller efficiency with wholly submerged propellers, it has usually been the practice to resort to one of the following methods: first, the formation of tunnels in the stern of the vessel, so that propellers of comparatively large diameter in relation to the draft may be completely covered with water when at full speed; second, by using side-wheel paddles; and, thirdly, by using stern-wheel paddles.

Now, though the propulsive efficiency of propellers in tunnels is better than could be obtained with smaller propellers wholly submerged, nevertheless the efficiency is of a low order, and does not compare favorably with either side or stern paddle wheels. Notwithstanding, it has the advantages which flow from high revolutions per minute, such as lighter machinery and greater compactness and security.

Although side paddle wheels have a higher efficiency than propellers in tunnels, they have the disadvantage associated with relatively low revolutions per minute, much greater overall breadth of ship, and the liability of the wheels to damage.

The stern propeller has a higher efficiency than the first two methods mentioned, but it has the disadvantage of greater overall length of ship and wheels, and a greater liability of the wheels to damage. In addition to the three methods mentioned there are two others—the water-jet and the air-screw methods; but these are shut out of commercial use because of their very low propulsive efficiency.

The advantages of twin vane-wheel propulsion are the high propulsive efficiency; the great maneuvering power; the effective variation of water acted upon with variation of draft, and therefore of variation of the thrust required; the higher revolutions per minute than side or stern paddle wheels, with consequent saving in weight of machinery; and, finally, the wheels are stronger and lighter than side or stern paddle wheels. Indeed, the experiments showed the wheels to be so very efficient as to warrant their adoption in many cases in vessels of deep draft; thus the actual results obtained from measured-mile trials of a twin-screw vessel, which was first tried with twin-screws, and afterwards with vane-wheels driven by leather belting from the main engines, gave the following results:

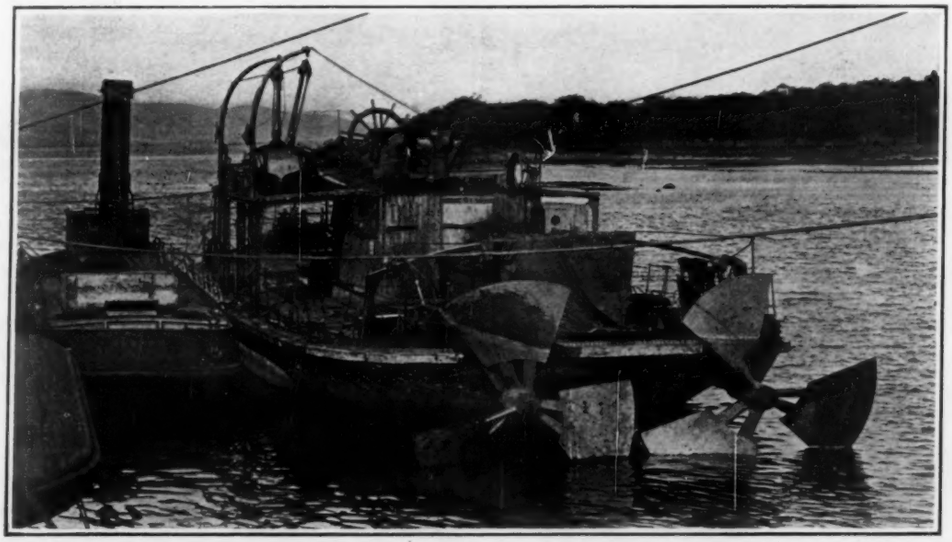
The vessel, as shown in our illustrations, measures 100 feet by 23½ feet, with a mean draft of 4 feet 6¾ inches, a displacement of 186 tons, and a speed of nine knots. The standard screw propellers are 4 feet in diameter, and the vane-wheels 11 feet, the pitch being respectively 5 feet 8 inches, and 16 feet. The revolutions of the screw-propellers were 226, and of the vane-wheels 66 per minute. The shaft horsepower of the screw-propellers was 197, and of the vane-wheels 116.

Now it will be seen that the vane-wheels gave the same speed as the twin-screws, with 41 per cent less shaft horsepower. The Dennys confirmed this by the measured difference in oil consumption, allowing for the loss due for the belt drive. The propulsive efficiency of the twin-screws was rather low, though the resistance of the shaft brackets and projections, together with the effect of the small immersion of the tips of the propellers, would probably not permit of a much higher efficiency being obtained. But it is evident from the above data that in evolving a new design for a vane-wheel vessel, if the speed is fixed, considerably less power will be required with vane-wheels than with twin-screws for the same dimensions and form of ship.

Another advantage which developed during the trial was that a vane-wheel vessel can be made to turn rapidly about its own axis without advancing. Particular attention should be drawn to the fact that whereas side and stern paddle wheels lose their propulsive efficiency when they are over-immersed, or under-immersed, it is found that in vane wheels every portion of the immersed vanes is applied effectively at all drafts. That is to say, the wheels permit of considerable variation of immersion, so that at the deeper drafts they have the advantage of acting efficiently on a greater sectional area of water. Hence, the revolutions per minute and the slip for the speed are not so variable in terms of draft variation as with the other available methods of propulsion of shallow draft vessels.

In conclusion, something more should be said in explanation of the causes of the surprisingly high propulsion efficiency developed, when vane-wheels were substituted for the original completely immersed propeller wheels. In the first place, the hubs of the vane-wheels are out of the water, and therefore involve no extra resistance, as in the case of ordinary screw-propellers. Again, the wheels do not require any immersed supports, such as brackets extending from the hull of the vessel to the shafts, as in totally submerged screws. Furthermore, every portion of the immersed vane is acting efficiently during its passage through the water, being in this respect superior to the floats of paddle wheels. Lastly, vane-wheels are more favorably placed in relation to the flow of water around the hull than are the ordinary screw propellers or stern paddle wheels.

The results obtained in these trials are remarkable. They prove that for vessels up to a certain size, operating in shoal water, vane-wheels show a remarkable gain in propulsive efficiency.



Stern view showing the form of the vanes and their attachment to the propeller shafts. The efficiency results chiefly from the absence of drag, due to propeller shafts, hubs and struts being above water

Our Chinese Customers

One Answer to the Problem of How to Work Our Factories to Full Capacity

By H. G. Murray

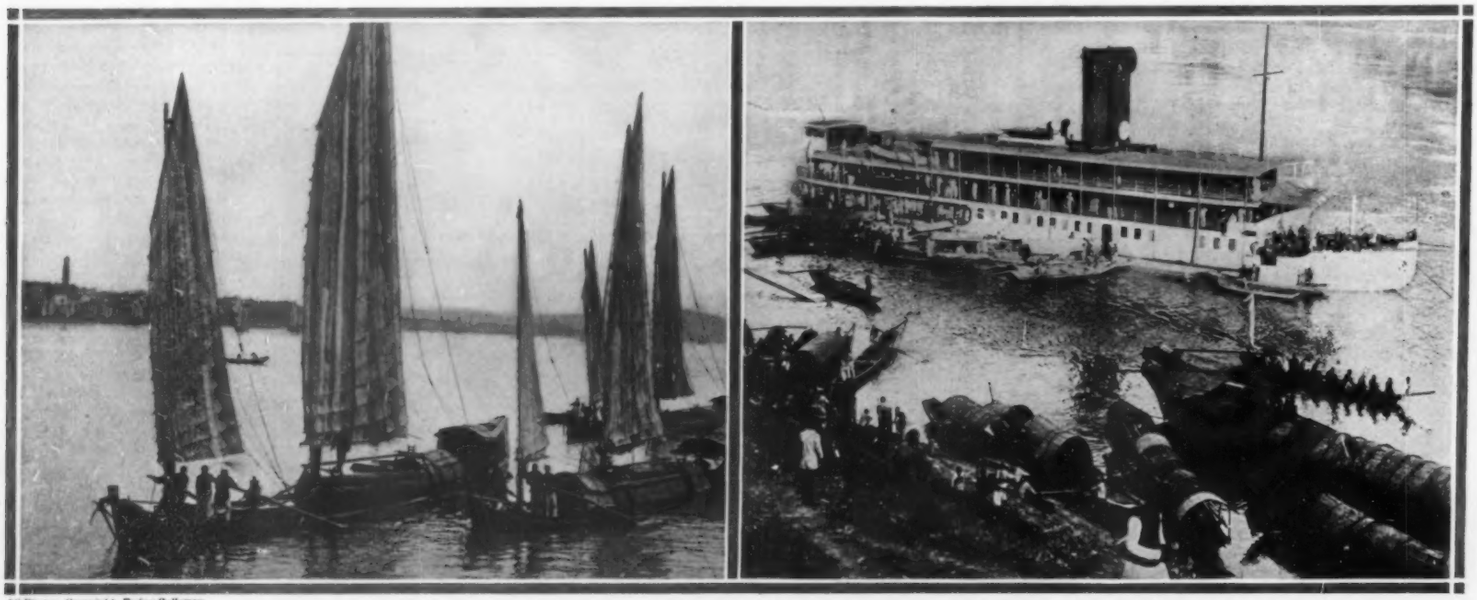
Floating a log raft down the Yangtze for sale at the mouth, while a whole village lives on it. When it reaches the market and is broken up, its population will migrate back to the headwaters in a regular boat

THE INTELLIGENT manufacturer in this country realizes that his future prosperity lies largely in export trade. For many years the rapidly growing West absorbed his output; but with its increase of population there has been a decided increase in its manufacturing plants, with the result that what was at one time almost entirely an agricultural area is now very largely self-sustaining. Hence the average manufacturer is forced to seek new outlets for his products. Mexico and Canada have naturally been the first foreign fields to which he has turned, to find, however, that even this new outlet is not adequate to his producing ability. Undoubtedly South America has been for many firms an excellent field and will continue to be so; but it is one in which a fierce competition is constantly waged with European countries, and which has been thoroughly exploited and developed by them. Europe possesses so many advantages for this particular trade which we cannot hope to duplicate that the American manufacturer must seek additional outlets for his commodities.

Unquestionably, China offers us an opportunity which is quite unique. Geographically it lends itself more readily to export trade from this country than Europe. Possibly the average manufacturer does not realize that from San Francisco to Shanghai, the metropolis of China, is only 5000 miles by sea, whereas from London to Shanghai is 11,000 miles, more than twice the distance. Not alone are we geographically situated to our advantage in comparison with European countries, but also there is no strain of consanguinity to be overcome, as there is between Europe and South America. Moreover, the factor which counts the most heavily in our favor is the entente which exists between China and this country. We have ever stood the staunch friend of the Flowery Kingdom, as a nation giving her what is slangily but abruptly termed "a square deal" in all international questions. We have never "assimilated" or annexed any of her territory as a punitive measure, nor has the recent Washington Conference on China's problems lessened the regard she has for us. Without exaggeration it may be said that the Chinaman regards goods from the United States very much as the American woman regards apparel from France—the label going a long way toward making the sale. This is no mean asset in international trade. In fact its value cannot be overestimated; and the American exporter will in all his dealings with China be wise to bear the fact in mind that this entente has been built up through mutual good will and understanding and can only continue through honorable dealings. Excessive prices, goods inferior to samples, repudiation of contracts, etc., are among the practices of unscrupulous foreign traders. While the Chinese deservedly enjoy the reputation of being the most honest of men, and while they are open-minded and can make allowances, they are quick to learn. A few tricky dealings will make the average Chinaman weary of trading with foreigners, and unfortunately he is taught how to retaliate in kind. There is probably today no country in the world where a trader from the States, who understands China and the Chinese, can trade more easily and advantageously; but there are too many indications that questionable Western methods are rapidly being learned by the Chinese trader. If the old type of Chinese merchant, whose trust and good faith have been a by-word, is to endure, the foreign trader must deal fairly and honorably.

Though the United States is most favorably regarded by the Chinese, it must not be concluded that the individual American shares the same high regard. American exporters as a whole have much to learn; and the most necessary lesson is that of selecting the proper type of salesman to represent them in China. It was recently stated by a large American export house that over 60 per cent of the salesmen they sent to the Orient a few years ago were failures, the majority of the men being unable to cope with alien customs or to withstand the temptations of Eastern life; but when older and more experienced and tactful men were sent an instantaneous improvement in their sales was seen. Differences in customs, religion and language make a wide breach to be overcome in trade. Tact, courtesy and patience must be possessed by the individual who desires to trade successfully in China; but these qualities unfortunately are too seldom possessed by the American salesman. This lack has contributed more than anything else to the dislike, frequently remarked, that the Chinese show toward a citizen of the States. The American house, therefore, that wishes to build up a trade with China should be most careful in the selection of its representative, and should impress upon him the fact that the Chinese are steeped in the traditions of the East and that high efficiency methods, as we know them in this country, are better calculated to spoil than make a trade in China. Germany, in the past, has erred in this particular to her own undoing, whereas the English with a more thorough understanding of Chinese character and prejudices, bred no doubt through a century's contact, have tactfully intrenched themselves, until today in a number of treaty ports there may be found English settlements which are centers of trade for the surrounding country.

The present Republic of China has an area of approximately five million square miles, more than twice as large as that of the United States; and a population four times as great as ours. Much has been written about China's population and estimates have run as low as three hundred millions and as high as seven hundred millions. Careful and conservative estimates, however, have placed its population as four hundred millions, and when it is realized that this enormous



All Photos, Copyright, Ewing Galloway

Left: Heavily-laden junks on the Yangtze. *Right:* The Shu Hun, largest and most powerful of the craft that buck the rapids of the main stream

Navigation as it is practiced on the Yangtze River

country with its swarming millions is practically non-manufacturing, as we understand the term, it can be readily seen what a great opportunity is offered the American manufacturer who will approach the matter of introducing his goods and pushing them in an intelligent manner.

There are practical opportunities in China for the sale of nearly all American commodities. For example, a few years ago the automobile was unknown, but today there is a steadily increasing demand; during a five-year period there has been an increase of over 1000 per cent in the sales. This means of course that the entire automobile accessory industry has an opportunity of selling. With the increase of automobiles there has been a growing demand for better roads, which in turn gives a chance for the sale of road machinery. One thing leads to another and it is not possible, therefore, to place any limit on what may be sold; for while there is extreme poverty in China there is also great wealth, and the Chinese, when they can, buy the best. They will buy anything of which they can make use.

The greatest opportunities at present lie in steel products; that is, machinery, hardware, railway supplies, electrical appliances, automobiles, etc.; bags of all kinds; building materials; casks; cotton cloth; sweets; tobacco; clocks and watches; soaps and toilet articles; dyes; drugs and medicines; gasoline; rubber goods; matches; surgical instruments; acids; safes; paper; provisions; sewing machines; phonographs; and household equipment.

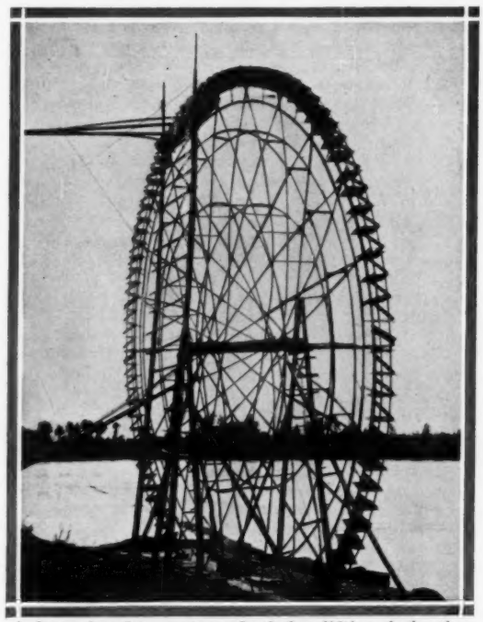
Under agreements made between China and other foreign countries, trade with aliens is restricted to what are termed Treaty Ports, forty-eight in number. It is only in these ports or cities that foreigners may reside, engage in commerce, or hold land; but these ports are well scattered throughout China proper and comprise many of the principal cities such as Canton, Shanghai, Tientsin and Soochow, Foochow, Hangchow, Hankow, Nanking, Ningpo, etc. However, no restriction is placed on traveling and appointing Chinese agents in other centers not Treaty Ports.

China has a background of five thousand years, which cannot be shifted by a salesman in half an hour. While this may seem to the uninitiated a disadvantage, it has its decided compensations; for, slow as the Chinaman is to take up with something new, he is equally slow to change from a foreign house with which he has established agreeable and satisfactory relations. This fact of course makes the Chinese buyer extremely desirable and places him among the assets of the foreign firm with whom he is dealing.

Quite a number of American manufacturers have sent able and progressive representatives to China, where a careful study of conditions has been made. Such houses have then established offices in China and with carefully trained salesmen and intelligent advertising have pushed a vigorous and successful campaign for their wares. Such methods are unquestionably the best for a house that has the income and patience to make a thorough survey of the country, give the necessary time to training competent salesmen, and invest many thousands of dollars before making sales of magnitude. But good as these methods are, they are unquestionably beyond the means of the average manufacturing firm. Realizing this, many have made the mistake of selling outright to a European house the right to sell on a royalty basis in China. There are not a few American firms today who are, through such contracts, debarred forever or for a long term of years from doing business in China; and while they may be in receipt of a large income annually through sales of their commodities in China, they have surrendered to a foreign house the margin of profit which goes to the European house and, what is of vastly greater importance, have suffered a loss of prestige or advertising value, not only for themselves but for the United States as well.

For many years it was extremely difficult for an American to transact business in the Orient, owing to our lack of direct cables, banking facilities, ships, in fact all the facilities necessary for the building up and maintaining of an export trade. In truth, for many years this country was practically compelled to clear through London for Far Eastern trade and it is only recently that we have established direct banking, shipping and telegraph connection.

The Hanyang Steel and Iron Works dispose of the notion that China has no factories at all



A huge bamboo water wheel for lifting irrigation water in Szechuan Province

The famous Fushun colliery in Manchuria, showing half a dozen distinct veins of coal

With no desire to preach jingoism (the more so as the Chinese are singularly devoid of this attribute and are disgusted by it in others), there must be impressed most emphatically the necessity of establishing direct dealings with China, if the United States is to be properly developed for trade with that country. For some occult reason a large majority of Americans labor under the delusion that in a foreign country they will be wiser to employ a European as a salesman. Now so far as salesmanship is concerned, the American is not inferior to any other nationality. He is frequently handicapped by a lack of knowledge of the language and customs of the country in which he is selling, but if he be familiar with both of these he will be the best for American goods; for he knows his own country, American business methods, and his goods as no foreigner can, with rare exceptions. Moreover, he has a loyalty to American products that it is not reasonable to expect in a citizen of another country. Where an American salesman can be employed, therefore, in China, other things being equal, the American house should employ one. But the house should make certain, before they engage his services, that he is thoroughly familiar with China and Chinese trade customs, and the requirements of his calling; and, above all, that he realizes that the Orient cannot be hurried, and that certain customs of the Chinese, however absurd they may seem to him, are not so to them, and in many cases are really not so ridiculous as some of those of his own country. Also they should make certain that the salesman, if he be from China, is not a piece of human driftwood floating about from job to job, nor one with a superficial knowledge acquired in a brief trip to China, and a glib tongue backed by unlimited conceit.

Therefore, that the name of the United States may become better known, as a country fully capable of producing goods such as are demanded by China's needs, the manufacturer, whenever possible, should deal direct and avoid making contracts with foreign houses and salesmen in London, Paris or elsewhere to market his goods. For if he does this it is inevitable that the Chinese will think the articles emanate solely from the European city which is headquarters for the agents, with a corresponding loss to the United States in trade relations, and a gain for a competing one. Also it is natural the Chinese should increase their trade with the country serving their demands. No surer way of killing trade relations with China can be devised than this method of selling American goods.

A majority of American houses that cannot afford to open offices in China, equipped with well-drilled salesmen, or whose margin of profit on sales will not permit of such overhead expense, advertise in export journals, published in this country or in suitable periodicals in China, calling attention to their wares and offering to sell direct on receipt of cash in advance or on the establishment of satisfactory credit. The Chinese do not as a rule buy that which they cannot see, or with which they are unfamiliar. Moreover, the long time which must elapse before a reply is received from a letter of inquiry in the majority of cases prevents the sale of the advertised product, unless it be greatly desired. While this method of selling is undoubtedly the simplest, it is bound to yield smaller returns than where the goods can be examined and bargained for in the principal trade centers in China and meet the advantage of quick delivery.

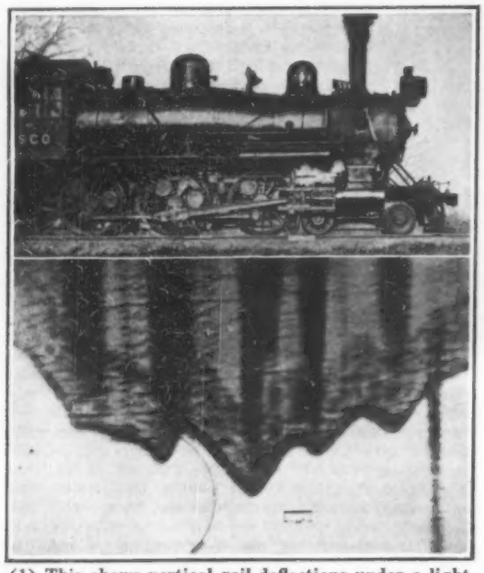
Unquestionably the best method of selling for the house that would not find it profitable to have its own establishment in China is to employ, on a commission basis, a reputable and established importing house with a branch in this country, a headquarters at Shanghai preferably or some other center in China, branch offices, and a well-trained staff of salesmen, familiar with trade conditions, throughout the Kingdom.

Through the employment of such a house, the American manufacturer has at once at his disposal an organized and efficient sales agency, conversant with the customs, trade conditions, wants, etc., of China. The fact that such a firm has an

(*Continued on page 367*)

When Tracks Tell Their Troubles

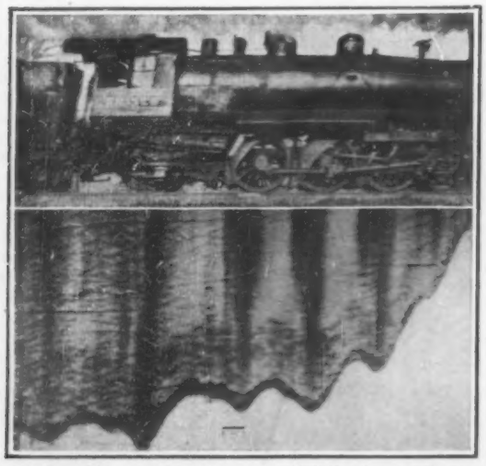
New Method for Determining Deflection of Rails Under Traffic



(1) This shows vertical rail deflections under a light locomotive that is starting to move

THE continual increase in the weight of locomotives and cars causes the question of the stresses in steel rails, ties, and ballast to stand in the fortfront of the problems confronted by the rail maker and the maintenance-of-way engineer. It is difficult, or rather, it has been difficult hitherto, to estimate with any accuracy the stresses which occur in the various portions of the steel rail when heavy locomotives and cars pass over it at varying velocities. If each tie were absolutely unyielding and its point of bearing against the rail above it were a blunt knife-edge, it would be possible to make a theoretical determination of bending stresses with close accuracy. But the tie and the ballast beneath it are both compressible, and they yield in varying degrees, proportionate to the quality of the track; and this has rendered the accurate determination of the local rail stresses produced by concentrated wheel loads very difficult.

The remarkable set of photographs which accompany this article shows an entirely new method for determining rail stresses, which has been developed by Mr. H. F. Roach, of St. Louis, Missouri. Mr. Roach brings photography to his aid, and in order to establish a plane in the track, a white chalk line is drawn on the side of the head of the rail, and this white line is photographed as the load passes over it. Any vertical distortion of this line represents the net distortion of the rail.



(2) Graphic representation of rail deflections under a heavy passenger locomotive moving at 55 miles per hour. These graphs are 400 times the scale of the photographs

Our various illustrations are reproductions of photographs of this white line; and as the amplification of 400 occurs in the relation of abscissæ to ordinates, the greater portion of the white line is necessarily thrown off the picture. Hence, we see only the upper edge of the white line; but, at the same time, we get an accurate description of the rail. Now, we know that there is a definite relation in solid bodies between the intensity of the stress and the amount of the accompanying strain. No body is so rigid as to remain unstrained or undistorted under the application of any finite force, however small. Mr. Johnson, in his "Theory and Practise of Modern Frame Structures," brings out this fact, and he goes on to say that "within a certain limit (the elastic limit) for any particular material, a given increase in the external force is always accompanied by a proportionate increase in strain or distortion; and this develops a like increase in stress or resistance."

Now, this method has been used in the study of rails in the eastbound track of the St. Louis-San Francisco Railway, near South Webster, Missouri, and the accompanying pictures show the photographic results. Thus: Number 1 shows a light passenger locomotive that is just starting its train. The maximum stress in the rail, under conditions shown in this photograph, is 63,390 pounds per square inch. Note the intensity of the stress immediately beneath each wheel. View Number 2 shows a heavy type of passenger locomotive while running at a speed of 55 miles per hour. The maximum stress in the rail, with conditions as shown by the graph in this photograph, is 36,810 pounds per square inch. The rail distortion is shown very clearly in the photograph. Number 3 represents the effect on the rail of a heavy freight engine, running at a speed of 25 miles per hour. The fourth photograph shows the rail stress imposed by a locomotive wheel at the moment of passing a joint.

The track on which these tests were made is laid with 90 pounds of rail, supported on good ties, and laid in excellent ballast, with good drainage. The point at which the investigation was made is on a tangent. It is claimed by Mr. Roach that by his method it is possible to determine: (1) rail stresses at any point, for any position of load or loads; (2) points of maximum stress; (3) stress in rail joints at any position of load or loads; (4) the performance of the counterbalance of the locomotive drivers, both collectively and individually. The photograph also shows whether or not the equalizers are properly installed so as to distribute the load over the respective drivers as intended; (5) the tie reactions; (6) the work being done by the ballast.

The value of this method of determining stresses lies in the fact that the results are achieved without any interference by man. The graph is made by the whole weight of the train and by the concentrated loads at the points of wheel contact. The process should find a field of application in the investigation of stresses in bridges, due to live loads; and it will be useful in laboratory investigations of tension and compression. It opens up the way for investigation in many directions—in reducing to absolute values problems that are now uncertain, and the results of investigation at best only approximate.

Harnessing Heat from the Sun

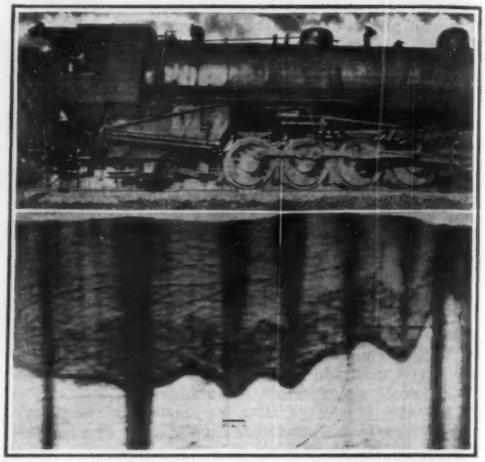
HARNESSING and storing the heat of the sun will doubtless for some time remain in the realm of visionary things insofar as its utilization has any appreciable degree of application. However, Dr. William W. Coblentz of the United States Bureau of Standards has designed a diminutive instrument capable of cornering heat from light rays, the device being described as a thermal generator. A test record on the apparatus shows: volts, .035; amperes, .0175; and efficiency, one part in 10,000.

The apparatus involves a series of thermocouples built up in units with the wires so proportioned that the difference in temperature between the hot and cold junctures of the thermal elements, when a strong light from the sun is admitted, is such as to produce a current of electricity. The principle as applied to a thermally-insulated box covered with two or three sheets of common window glass is so efficacious as to insure a rise in temperature of 100 degrees Centigrade or more above the surrounding temperature, in winter or summer.

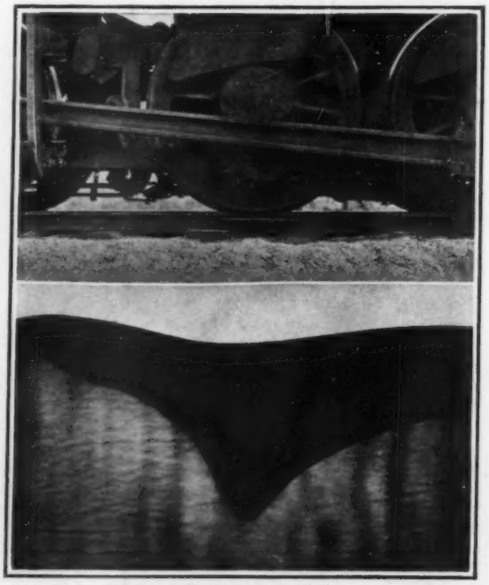
The object of the invention is to demonstrate the possibilities of the utilization of light rays in generating an electric current of sufficient capacity to do useful work. The casing is of wood, with a layer of concrete deposited therein which, as a good insulator, prevents short circuiting between the thermal elements. The latter may be of bismuth in one instance and copper or iron for the other element. They are embedded in the layer of concrete. The thermal elements are connected to one another above and below the supporting member, which is of concrete. At this juncture the receivers are soldered with a thin layer of asphaltum which will absorb a substantial portion of the incident light.

The two elements are arranged in parallel rows, being in appearance but rows of small, short wires. Mounted in the casing above the layer are one or more sheets of glass, separated by air spaces. The box portion of the casing and the sheets of glass are more or less air tight, thus avoiding the connection of heat. The diameter of the wires is such that the loss of heat by conduction is at a minimum.

The cold juncture lying below the supporting member of concrete is shielded from the light or heat by walls, or, if preferable, these portions can be submerged in water. The tiny structure, not exceeding in dimensions that of a large magazine, causes such a difference in temperature between the hot and cold junctures of the thermal element, when strong light from the sun is admitted, that a current of electricity is produced of sufficient strength to do work.



(3) Deflections of rail under a heavy freight locomotive running at 25 miles per hour



(4) This shows deflection caused by a locomotive wheel when passing a joint

Putting Glassware Through the Testing-Mill

IF the specifications required for tumblers used by the Army, Navy and Marine Corps could be applied to milk bottles and preserve jars and glasses, a reduction in expense and greater satisfaction would result to milk dealers and canners, not to mention household and hotel users of glassware. The Bureau of Standards intends fixing a standard, not only of size in these articles, but quality as well, subjecting them to the tests now applied to tumblers for use in the Federal service.

Milk bottles, for instance, must be sterilized every day, and the fact that the bill of one New York dealer, for bottles alone, for one year, was $1,000,000, shows how poorly constructed they are to meet this test. The same applies to preserve jars which must be sterilized and filled with boiling liquids, and how often the domestic preserver has had one crack in the process is well known to every housewife.

There are two tests applied to tumblers by the Bureau, a shock test, and a boiling test. The samples are made of either pot or tank lime-flint glass, either hand or machine made, and hand or machine fire-polished. They are required to be reasonably free from flaws and bubbles, and of fairly clear color. To withstand the following tests they must be insoluble in water and well annealed. The shock test consists of pouring boiling water into the sample, at room temperature, until full, and to be acceptable the tumbler must not crack, although subjected to this process five times.

The second or boiling test determines their resistance to sterilization, for the tumblers are completely immersed in distilled water in a closed vessel having a small vent, and boiled continually for six hours, the water being kept at a uniform height by occasionally adding a little to compensate for evaporation. The results of this test are shown in the illustrations. The second glass, being of poor quality, went completely to pieces on a twelve-hour test, while the other merely cracked.

As these tests are more severe than glasses would be subjected to in ordinary use, they give a fair margin of safety.

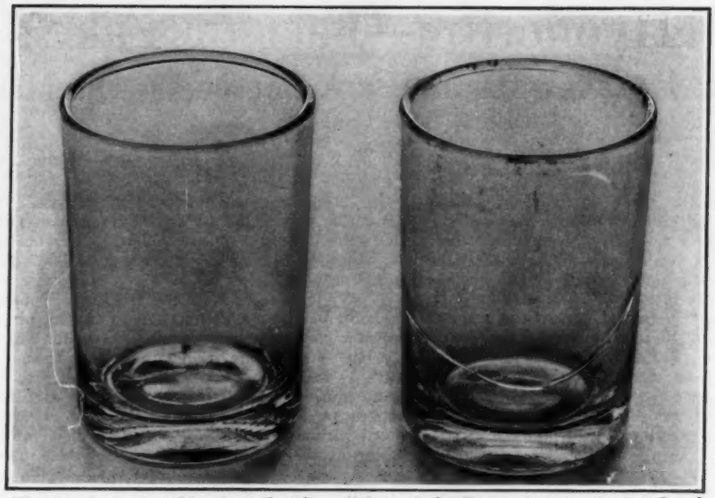


Fig. 1: An acceptable glass that has withstood the Bureau's test; the left-hand view shows the condition of the specimen after six hours, the right after twelve

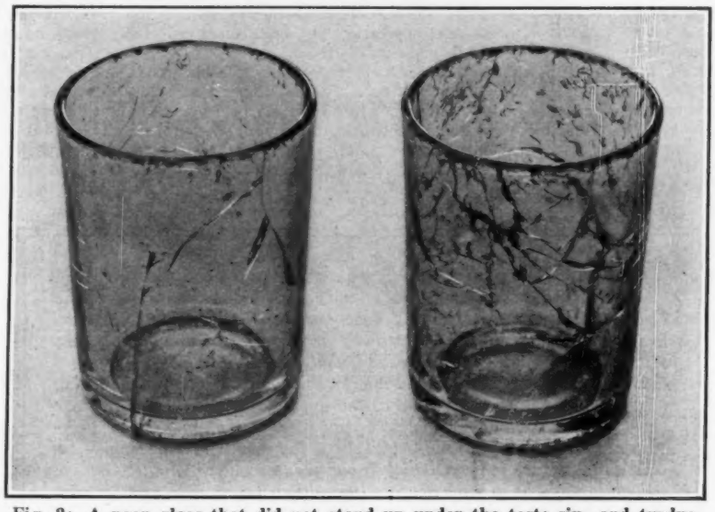


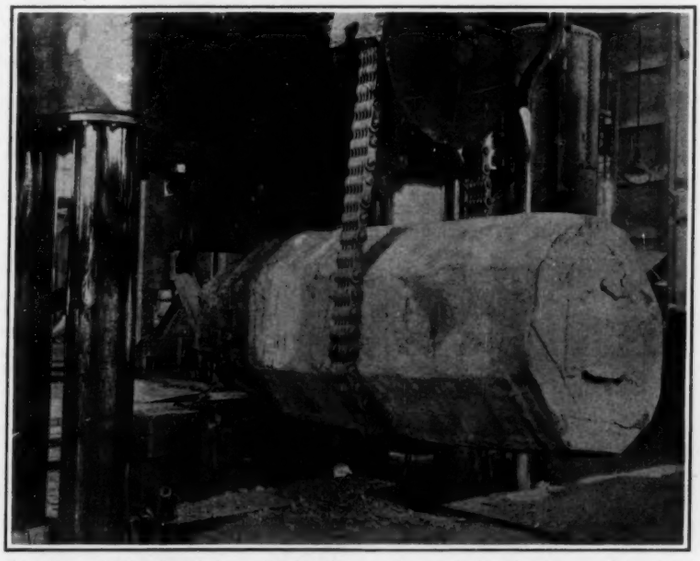
Fig. 2: A poor glass that did not stand up under the test; six- and twelve-hour showings as above

Applications of the Thermionic Valve

THE control of energy at distances of thousands of miles without any other medium than the ether has been made possible by the evolution of the thermionic valve. This remarkable invention can be described briefly as a highly exhausted glass bulb, in which is mounted a tungsten or tantalum filament heated by a battery giving about six volts. Electrons are emitted by the heated filament. The filament is surrounded by a grid or gauze cylinder, which is insulated and kept at the negative potential of the filament, while a plate of metal mounted inside the bulb is kept at a high potential of from fifty to several hundred volts by means of a battery or some other source of continuous current. The bulb is highly exhausted, and while the grid is kept at a normal negative potential, steady current passes from the filament to the plate or anode, but as soon as the grid is made slightly positive or negative, the current passing between the filament and anode by virtue of the electronic conductivity is increased or decreased. A valve can be used as a rectifier, as it can be made unilateral in conductivity by suitable adjustments of "grid potential." It can also be regarded as an inertialess relay, it being only necessary for the grid to be affected by the most minute change of potential for the valve to become more or less conductive, when it may be used indirectly to close a circuit and control magnetic or electrical operations.

One of the most important applications of the valve is the amplification of telephone currents in long-distance trunk lines. Another recent application is the magnification of the sound of the heart-beat. This is effected by means of a special transmitter, which rests by its own weight over the heart of the patient under examination. The valve has also been used for the simultaneous reproduction of speech with the projection of a film on a screen, both picture and sound vibrations being photographed simultaneously on the same film, thereby ensuring perfect synchronization. The vibrations of the voice are, by means of microphones, made to agitate a small mirror fitted on the camera adapter and a shaft of light passes from the mirror through a narrow slit. As the mirror vibrates, the band of light is reflected at constantly changing angles, and a wave form is produced which corresponds to the vocal sounds of the person speaking, as in the oscillograph. The wave form appears on the side of the film and is reconverted into sounds by means of a selenium cell, which, as is well known, possesses the peculiar property of resisting the passage of electricity in proportion to the intensity of light to which it is subjected. The variations in resistance caused by the passage of the film through the cinematograph are amplified by thermionic valves and made audible through a loud-speaking telephone. There are wide possibilities in the application of the valve.

Probably the most interesting application of the thermionic valve is its use in radio-telephony. Here the valve is used to generate continuous waves in a suitable circuit and, by means of a microphone, the voice of the speaker is made to vary the amplitude of this wave at the different audible frequencies which are used in speech formation.—Abstract from *Nature* for April 22, 1922.



Forging a 60-ton ingot by swinging it on a huge chain-belt of vanadium steel

The Great Problem of Evolution

AS the conclusion of a valuable paper on "The Effects of Environment on Animals," in the *American Naturalist* for April, 1922, Professor A. S. Pearse of the University of Wisconsin says: Living systems of activities are adapted to the environment; they respond to the environment by transformation, selective survival, or migration; each habitat limits the patterns of the systems that exist within it; and, finally, though adaptation to environment may permit precise adjustment to rhythmical changes extending over considerable periods, and though animals generally become most specialized when conditions are most stable, there is no evidence that living systems are caused to change from one species to another by the transformations of habitats due to physiographic succession. The pattern of evolution is set by environment, but there is little or no evidence that changing environment causes adaptive variations of such a degree that new species are produced. Animals adapt themselves to environment by changing their systems of activities, but such responses are apparently limited in extent to the inherent possibilities of variation already within the system. Animals have great powers of adaptation to environment, but are not fundamentally changed by it. Environment permits evolution and controls its course, but does not appear to cause it.

A Tough Job for a Giant Chain Belt

THE accompanying photograph tells quite a story—two stories, in fact. The obvious one has to do with the unusual use of a chain, and the extreme size and sturdiness of the chain necessary for this use. The huge ingot which it supports weighs 60 tons, and the only practicable way to forge it involves swinging it in this chain-belt cradle. We are quite accustomed to seeing chain belts of this construction on bicycles, on the front drive of our automobiles, and in machine drives generally; but to see such a belt swinging 120,000 pounds of white hot metal is a bit novel.

But that is not all there is to the picture, by a good deal. Belts of this sort have been used for this service for some time. Their life was from three weeks to a month. Then it occurred to some bright young man to make them of vanadium steel. They cost more, so made; but the one in the picture has been in service over two years, and is going strong, so they are worth more.

Hypnotism—Fact or Fake?

What Modern Science Has to Say About an Age-Old Manifestation

By Donald A. Laird

Assistant Professor of Psychology, University of Wyoming

POPULAR abuse by vaudeville performers and sensational journalists has brought many genuinely scientific subjects into disrepute. This is the case especially with hypnotism; practically all its manifestations with which the average person comes into contact smack of deceit. The usual "professional hypnotist" of the vaudeville circuit carries with him from town to town his subjects who are paid to sit in the audience until his act opens; then they volunteer their services and the so-called hypnotist makes a few mysterious passes over them.

Back of all this charlatanism there is a large body of scientific facts vindicating hypnotism. Genuine hypnosis is as well established as any portion of science can be. It has been studied for several decades and is now fairly well understood. The hypnotic state may appear spooky through its unusualness, but it is not mysterious or miraculous.

"Weakminded" people are not the only ones who can be hypnotized. As a matter of fact, idiots and imbeciles are the most difficult subjects. Under the right conditions practically any normal person can be easily hypnotized. There is some evidence that even the lower animals can also be hypnotized.

I have said that there is nothing supernatural about hypnosis. But the scientist must not merely tell what people will do when they are hypnotized. He must also tell why this changed condition is brought about. And, if possible, new facts must be explained in terms of those which are already in existence. It would often be easier to concoct some new force or power to explain things; but the careful scientist must explain in terms of facts already firmly established. This is one reason why spiritualism is not accepted by scientists.

Hypnotism is no doubt as old as the human race. We can trace hypnotic phenomena back several thousand years. Many of the early historical religions were apparently due to auto-hypnosis. The Egyptians foretold the future by gazing intently into vessels filled with water. Then when they saw visions in the globe of water they were called divinations. This is one of the characteristics of hypnosis. Undoubtedly the visions of the modern crystal gazer are analogous phenomena — when they are not intentionally faked.

Seeing, feeling, and hearing things that do not exist is known as hallucination. The hypnotized person is hallucinated. The hypnotist tells his subject that an onion is an apple and the subject will munch it as if it really were an apple. If he is told that there are tacks on the carpet he will step gingerly around them. Hallucinations are also common among the mentally disordered. But when a person is hypnotized he is under the control of the person who hypnotized him. He sees what he is told to see, he does what he is told to do. The mentally disordered person is not so thoroughly controlled by others. Very often it is just the opposite. Tell a mental patient to raise his hands and he will force them all the deeper into his pockets; tell him to stop hearing the voices from the tree tops and he will keep right on hearing them.

Through the ages there gradually developed the conception that there were *certain people* who had the power of bringing others under their influences, as is the case in hypnosis. Along with this went the notion that there was a certain particular force that made this possible. For a time in the Middle Ages this force was attributed to the stars. Later it was transferred to the moon and is carried down in the word lunatic. Early in the eighteenth century magnetism was the explaining principle, and by the latter part of this century so-called *animal magnetism* came to be the key for explaining hypnosis and numerous other conditions. A Viennese physician by the name of Mesmer was the first to make extensive use of this concept. Mesmer traveled extensively, lecturing on the subject of animal magnetism and giving demonstrations of the use of this mysterious power. This was an interesting concept and flourished in an age when mystical affairs received much attention. Occasionally to this day one finds this antiquated conception afloat under the name of Mesmerism, electro-biology, or some other high-sounding but meaningless appellation.

There is nothing nearly so intricate and difficult of explanation about hypnotism as these old notions tried to make it. All the weird-appearing devices used by the old-time Mesmerists had no peculiar power that enabled them to put persons into a hypnotic trance. The hypnotist possesses no unusual powers. It is the subject himself that makes possible hypnosis, which can be as readily produced without apparatus as with it. The mysterious passes of the hands in front of the subject are also superfluous. They originated at a time when passing the hands toward the subject was conjectured to push the animal magnetism of the exhibiter into the subject; drawing the hands away from the subject was supposed to draw out the magnetism. Rather a pretty explanation, and the passes of the hands impress the spectator, but one can hypnotize as well without arms as with them.

Now we have the decks cleared of the familiar errors. All the notions which we have cast away are, scientifically, at least a century old, most of them are older. But it is just such notions as these that the average person nourishes about hypnotism. With a clear track ahead of us let us now take up what hypnotism really is and means.

AMONG the professional hypnotists who have adorned the cheap vaudeville stage and graced the county fair have been many who practiced fraud, carrying their "subjects" with them from town to town and indulging in other sharp dealings. But most of us have seen pretty convincing demonstrations that hypnotism is not all fraud—that certain persons possess, and many can acquire, the power of putting others into the condition known as the hypnotic trance. In one of our early articles upon the psychic we suggested that of all "queer" performances, hypnotism was least likely to be met with unreasoning incredulity; and we indicated that in our judgment it was largely normal though it might be in some degree also a development of psychic powers. Professor Laird here enlarges upon the theme, and without attempting to give working instructions for the budding hypnotist, he makes it clear on just what scientific principles the ability to hypnotize rests, and just what are its limitations.—THE EDITOR.

No one will deny that suggestibility is common to all mankind. There is nothing mysterious or uncanny about this. One person in a company yawns; soon several others catch themselves yawning. This is not imitation; in imitation there is a conscious attempt made to reproduce the actions of another. The yawning takes place in spite of one's best efforts to repress it.

The high-grade salesman puts across large business deals by suggesting certain actions; he does not tell his client to do so and so, but rather brings the deal to a head through the use of suggestion.

Under hypnotic conditions there is an exaggeration of this normal suggestibility. The hypnotized person will act upon suggestions that he would fight off in his more usual condition. A gesture from the hypnotist is enough to precipitate the desired actions in his subject; the more direct suggestion of command is accepted and acted upon without the least hesitation, though the most absurdly ridiculous things be ordered.

Suggestion is essentially acceptance of an idea uncritically and action upon that idea automatically. In hypnosis the subject never argues with the hypnotist; the idea or act suggested is accepted with no opposition. That is the first large point about hypnotism. In the second place after the idea is once accepted it is acted upon in an automatic way, without quite knowing why and in spite of any reflection on the part of the subject. In normal conditions suggestibility has these same characteristics, whether it be in yawning, obtaining a wrap from your escort, following the mob, or any other of a host of activities from daily life in which suggestibility is the main characteristic.

The spooky passes of the hypnotist are not directly related to bringing about the condition of heightened suggestibility as found in hypnosis. But they serve a distinct purpose. So does a button, if that is used in place of the passes. What the button or the passes do is to fixate the attention of the subject. This is the first step in successful hypnosis. The button is merely a means for bringing about a fixity of attention. A pin, or a pencil, or a lemon would serve equally as well. This is one reason why "weakminded" persons are hypnotized with difficulty; they do not possess the ability to gaze at so uninteresting a thing as a button for any length of time. The crystal of the crystal gazer serves the same purpose as does the humble button of our example. Whatever the device or procedure used, it but gives an object upon which the attention can be directed. All hocus pocus is unnecessary and of no real value.

Another condition essential to the production of the hypnotic state is monotony. The hypnotist repeats over and over again the phrase "You are losing control of yourself; you are losing control of yourself." A dimly lighted room contributes to the monotony of the situation; a droning, monotone voice also contributes. The passes of the operator aid in producing the hypnotic state through their monotony. The faint illumination and dismal quiet of the room results in a monotony essential for effective suggestibility in the seeress as well as in her clients.

The words of the hypnotist do not contain a magic formula. They have two purposes. The first is to aid in producing real monotony. The second purpose back of the chantings of the operator is to limit the field of consciousness to one thing: the idea of sleep. The hypnotist repeats again and again the thought of sleep. A condition of monoideaism is thus brought about.

One more element in the production of hypnosis and then to the peculiar effects that accompany hypnosis. Limiting the voluntary movements of the subject is one of the main conditions contributing to satisfactory hypnosis. The subject is placed in a comfortable position; he is instructed to remain as motionless as possible. It is doubtful if this limitation of movements is essential in a direct manner. More probably it facilitates hypnosis by assisting in fixating attention and adding to the monotony of the situation.

Hampering voluntary movements plays an important part in bringing about the heightened suggestibility of the mob. Crowded and jammed together the freedom of movement of the people in the gathering is greatly hampered. The political orator and the soap-box radical know that they can get more desired action out of a large crowd than out of a small one. People caught in a crowd will accept uncritically the selfsame notions that they would ridicule out of the front door if presented in the quiet roominess of their home. The limitation of voluntary movements is a great contributing factor to the suggestibility of the mob.

No special insight or powers are necessary for one to be able to hypnotize others. All that is necessary is to fulfill the conditions which heighten suggestibility.

The phenomena of hypnosis are striking, but not without parallel. We have previously mentioned the presence of hallucinations in hypnosis. These may be of two sorts. Negative hallucinations may be invoked at the suggestion of the operator and the subject will fail to perceive objects that are really there. In the other type the hypnotist suggests that the subject will perceive things which do not exist at all. The subject will attempt to wipe insects off his face, he will listen to hallucinatory strains of music and applaud at the close of the imaginary selection.

It is important that these hallucinations are induced only at the suggestion of the hypnotist. The subject does not evoke them spontaneously. It is partly in this that hypnosis differs from mental disorder. In disorders of mental functions the patient sees and hears things in spite of the attempts of others to prevent it. In the disordered mind the hallucinations originate within, in hypnosis they are suggested by another.

Disturbances of memory are usually found in hypnosis.

(*Continued on page 367*)

Eliminating Static by Means of the Resonance Coil

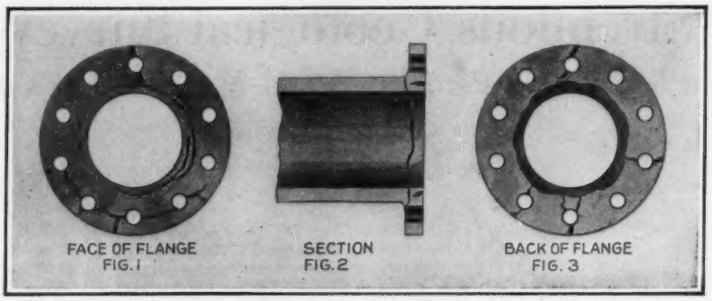
BY the use of a so-called "resonance-wave coil"—essentially a complete and compact wireless antenna—the Signal Corps of the United States Army claims to have developed a method whereby "static" or atmospheric disturbances as an accompaniment of orderly radio communications may be eliminated. It is merely repeating a statement of universal acceptance to say that static electricity or atmospheric disturbances is the big retarding factor in the development of radio-telephony. This discordant element in the reception of wireless signals is operative from June to October—about five of the twelve months in the year.

The device of the Signal Corps for instituting proceedings effecting the divorce of orderly wireless signals and the crackling, meaningless noises, takes the form of a drain coil of wire. The incoming signals, for instance, from broadcasting stations, traverse the so-termed "resonance-wave coil" and then proceed to the conventional radio-telephone receiving outfit, irrespective of the design—vacuum tube or crystal set. The noteworthy thing, however, is that this coil of wire or compact antenna is of a discriminating caliber and only wireless signals are admitted passage into the radio-telephone receiver. The atmospheric disturbance or static electricity, discordant note that it is, is sidetracked and conveyed to the ground. Such are the claims made for this new form of "static eliminator."

The length of the "drain coil" varies with the distance traversed by the communications that are to be received. The strength of the incoming wireless signals are not robbed of their robustness by the draining process, according to claims. Moreover, facilities are accessible for amplifying the messages. "Eliminating static noises has been one of the most serious problems in radio development," says Dr. Louis Cohen, consulting engineer of the Signal Corps of the United States Army. "Due to the electrical charges in the atmosphere, especially in summer, even the largest stations must shut down at times. This is a new and radical departure in receiving radio signals. The method consists in receiving the radio signal, passing it through a very long coil which drains off the interfering disturbances and leaves the full-strength signal without noises."

The application of the principle of the "resonance-wave coil" in the development of a method for the elimination of static electricity invites brief explicative text of this compact antenna. This coil is not only a complete wireless antenna, but its use obviates the need of a receiving apparatus other than a detector and a pair of telephones. It has been fittingly described as "a vest-pocket edition of wire-

(*Continued on page 368*)

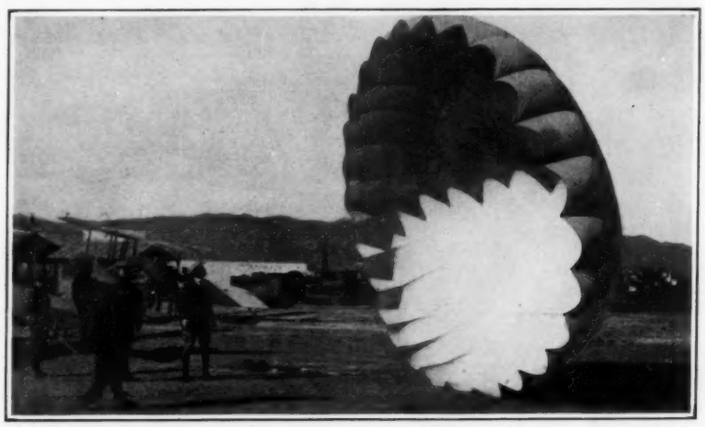


Details of an iron-pipe failure due to the influence of superheated steam

Handling the Parachute on the Ground

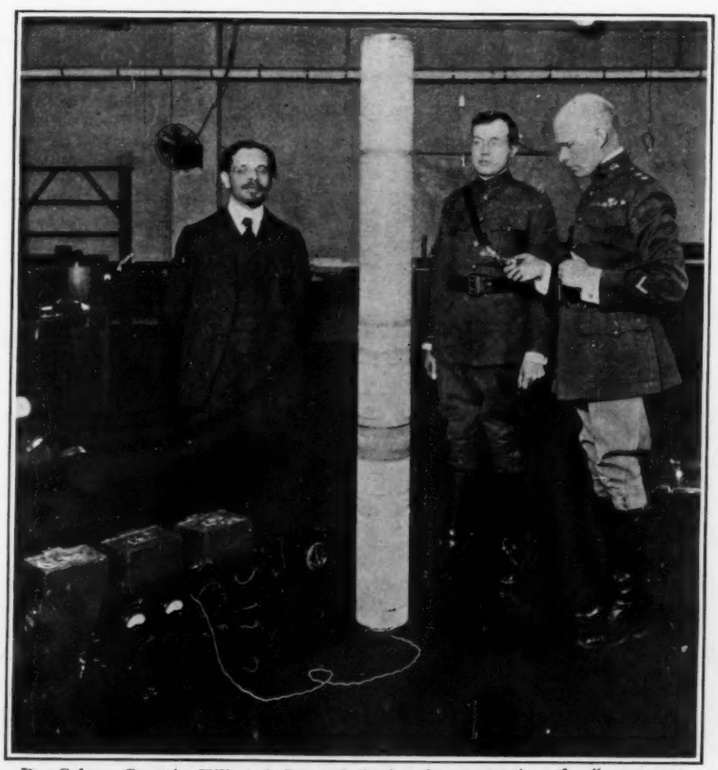
WHEN a parachute is being folded and packed for emergency use by airmen, seeing to it that the parachute is free from defects, and is properly folded, is a matter of paramount importance. Due to the great size and awkwardness of handling a parachute when it is folded on the ground, this task has always been rather difficult. The conventional method of conducting this operation heretofore has been to hang the parachute from a wire or other high support, inspect it in that position, and then carefully pack it—fold at a time.

Very recently, however, Frank Ungar, of Venice, California, a professional exhibition parachute jumper and aeronaut, discovered a more satisfactory method of inspecting and folding parachutes. Mr. Ungar unfolds his parachute behind the tail of an airplane, the motor of which is kept turning at a sufficient speed to create just the draft of air that is needed to hold the parachute open. While an assistant holds the service lines of the "chute," Mr. Ungar makes his inspection of the fabric. By holding the "chute" open against the sunlight the inspection is made from the other side, making the slightest rent or defect in the fabric almost instantly discernible.



Holding a parachute open for inspection and folding, by means of the draft from an airplane motor running idle at low speed

After the inspection is made the parachute is folded for further use by one man holding the vent, while another completes the folding operation by gathering the service lines together. This method has been found far easier than the same job with the parachute hung from a high support, or in a heap upon the ground.



Dr. Cohen, Captain Hill and General Squier demonstrating the "resonance-wave coil" for the elimination of static

Why Superheated Steam Causes Failure of Cast Iron

PROFESSOR CARPENTER'S well-known experiments on the growth of cast iron under the influence of high temperatures have thrown much light on this subject. Curious failures of cast iron parts subjected to superheated steam do occur occasionally, but by renewing these parts with special cast iron further failures are generally obviated. This experience coincides with Professor Carpenter's conclusions, that there is a great difference among different qualities of cast irons as regards their heat-resisting properties. Doubtless turbine and engine builders have at some cost to themselves discovered which cast irons give least trouble when brought into contact with superheated steam, but the makers of cast iron steam pipes have apparently no rules to guide them, with the result that failures among cast iron steam pipes, elbows and valves, if used for superheated steam, are of increasing frequency. When a pipe is used for conveying superheated steam its diameter apparently grows larger and larger, though the temperature may be considerably below that at which Professor Carpenter noticed any creeping. But the circumstances are not the same. In his case the metal was not in tension, nor in contact with steam. In his case, as well, the swelling of the cast iron was traced to the gradual oxidation of the silicon in the cast iron due to the penetration of oxygen into the metal. Steam pipes are, of course, not exposed to the action of atmospheric oxygen, except to a limited extent on their outsides; but it is well known that superheated steam will attack iron, as in the Barff process, and there are indications that even saturated steam produces changes in cast iron steam pipes. In fact, some chemists claim that they have proved that iron is soluble in water, the contact waters depositing red rust if exposed to air.

An interesting example of a failure of a steam pipe, which was said to be steel, but was evidently some special cast iron, is given by W. C. E. Stromeyer, Chief Engineer to the Manchester Steam Users' Association, and is shown in end view section and back view.

This casting was only two years old, but the numerous gaping cracks leave no doubt that the metal had completely lost its character. The inside of the pipe was coated with red rust, indicating chemical action. The two cracks which extend to the outside of the flange are much wider at the outside than near the pipe. This indicates that the pipe had swelled considerably, while the outside of the flange had not followed suit. The circumferential crack shown in Fig. 1 does not extend into the fracture (see Fig. 2), and can at present only be explained as being due to the material having lost all character. The superheater was installed in 1901, and there have been many previous failures of cast iron pipes in this range of steam pipes, including some of the renewed parts like the above. This suggests that change of material will not always counteract the effect of superheated steam. This case, and many others which have presented themselves, clearly demonstrate that cast iron should not be used for carrying superheated steam, unless it can be shown that special qualities of this material are practically capable of withstanding the effects of superheated steam.

Non-Inflammable Films

FOR some time back there has been on the market a non-inflammable motion picture film, made of acetate of cellulose instead of the usual nitro-cellulose or celluloid. Because of the many dangers incurred with inflammable films, France has passed a law whereby all films used in that Republic after June, 1925, must be of non-inflammable stock. Undoubtedly many other countries will soon enact similar legislation, making motion pictures safe.

Our Strenuous Geological Survey—IV

With the Men Who Have Penetrated and Mapped the Wilds of Alaska

By Guy Elliot Mitchell

United States Geological Survey

THE able administrative head of the board in the Geological Survey which for the past ten years has been classifying the public lands of the United States is W. C. Mendenhall. He sits at his desk with maps and reports and smokes fairly good cigars; and his trips in the western wilds are now rather few and far between. But he has had his share of strenuous outdoor geology and Alaskan experiences and privations. The official results of these trips are contained in voluminous reports on the geology and mineral resources of the Territory and on accompanying maps. The trying conditions under which the results were obtained will never be told, because they were considered simply a part of the day's or season's routine, and were accordingly given no place in official reports. But the narrative of a few outstanding incidents may serve to show that it was real work, work of which we may well be proud.

Way up the Yukon River in central Alaska the Dall River comes in from the north. Starting from its juncture with the Yukon with a party of five men and two Peterborough canoes one year early in June, Mendenhall ascended the Dall nearly to the Arctic Circle. At the headwaters of this river the water became so shallow and rapid that the canoes could be dragged no farther. The party then made an 18-mile portage across the intervening divide to one of the tributaries of the Koyukuk River. This necessitated crossing a mountain range 2,500 feet above the stream level, the men carrying the entire equipment—two boats, instruments, provisions, etc., weighing three-quarters of a ton.

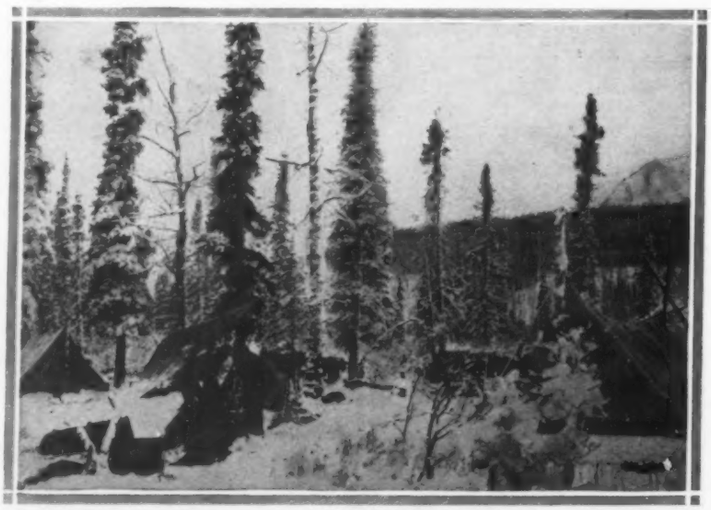
Dog teams on the Kobuk in the winter time, where this mode of conveyance is used for almost eight months of the year

The portage occupied all the concentrated energies of the party for nearly five days. After it was completed the canoes were placed in the waters of an unknown stream flowing to the north, and it was hoped that the Koyukuk would be reached without further difficulty. But after following the stream for a few miles through an open Arctic meadow its grade increased, its banks closed up, and the party found itself at the head of a canyon which proved to be 20 miles in length and within which the river dropped a vertical distance of 1000 feet. We may leave the rest of the story to Mr. Mendenhall.

"This stretch of the stream was a succession of wild rapids which ought to have justified the statement of the Indians on the Yukon that men could not go through it in boats and live. Our light Peterboroughs, however, were well adapted to lining down through the rougher rapids or shooting those that were not too badly broken by projecting boulders, and after a few days of fairly strenuous work we emerged intact into the open river below the canyon. Two or three canoes were swamped, but without serious loss of supplies; and on one occasion almost the entire bottom was ripped out of one as the current swept it over a jagged, submerged rock. By the use of emergency repair supplies and by collecting pitch from spruce trees to caulk the seams we got the boats into shape again in a few hours and continued on. The portage and the passage of the canyon, however, had consumed so much time that supplies were gone and for the last week before reaching Arctic City, a trading post on the Koyukuk, we subsisted upon one meal a day. This consisted of a stew made up of a handful of flour, with such rabbits, ducks and geese as could be shot along the river. Some days this stew was tolerably thin.

"Had we had time, we should have stopped to hunt for big game; we could have dried the meat into pemmican and had enough for a week or more. But we were late as it was, and we had to make the last boat out of Alaska, and we just did make it by the skin of our teeth. From Arctic City we continued northward up one of the tributaries of the Koyukuk beyond the Arctic Circle. Here we found a low portage across the divide into the Kobuk, a big stream which flows westward between 400 and 500 miles to the Arctic Ocean north of Nome. On this portage an incident occurred which threatened for a time to result in the loss of the season's supplies and to force a hazardous return across rough country 100 miles to Arctic City.

"Nearly all of our supplies were piled at the midway point on the portage. All the men except one had gone back for the last load when a fire which had originated in one of the smudges which we had started at breakfast time to protect us from the swarms of mosquitoes, crept through the oily reindeer moss that covers the tundra and ignited one of our three tents. The dry



Geological Survey camp near foot of Chugach Mountains in Alaska, after a night during which 21 inches of snow fell

cotton of this tent burst into flames, and in a few moments its blazing fragments were scattered over the oily moss and a dozen small fires had started. These were fought desperately by the cook, the only man who had remained in camp. The rest of us, however, saw the smoke, realized its significance, dumped our loads, and raced toward the camp to help extinguish the flames. Meanwhile another tent had burned, and when we rushed into camp, the fire was within a few feet of the season's supplies packed in paraffin bags which would have burned like tinder. It was touch and go, but our combined efforts soon extinguished the flames and saved the food supplies. Much clothing and many blankets however had been lost in the two tents that were consumed. We spent a precious day quilting fragments of burned blankets to canvas sheets made by sewing together flour sacks; in making substitutes for coats out of paraffin bags, and in patching sweaters and mackinaws with odds and ends of material that rendered each member of the party a rival of Jacob at his gayest.

"Thus reequipped, the Kobuk was descended without encountering any serious obstacles, although we ran a few rapids near its head. We reached Kotzebue Sound, a huge arm of the Arctic, and cruised along its shores in our light Peterboroughs, paddling and using our 'oilskins' for emergency sails for 200 miles to the mining camp of Deering. Here we were picked up by a Gloucester fishing schooner which had been transferred to the Alaskan coast, and after a rough passage of ten days reached the shallow coast opposite Nome. For two days the schooner lay off Nome waiting for the sea to subside sufficiently to permit a landing to be made. Two passengers became impatient, took the one small boat of the schooner, and attempted to make shore, but were swamped in the breakers and drowned."

Perhaps the worst and withal the most diffident old geologic scout in the Geological Survey is F. C. Schrader. You simply cannot get a word of "experience" out of him under any subterfuge. His official report of a geologic reconnaissance in Alaska, which is probably unparalleled in the annals of explorations, contains about a dozen lines of print describing a marching and paddling stunt of 300 miles through absolute terra incognita, and then a race of 600 miles along the uninhabited and inhospitable shores of the Arctic Ocean in canoes, Eskimo walrus skin boats, and finally a borrowed whale boat in an attempt to catch the last steamer out of Alaska for the season. The men paddled and rowed and sailed night and day—and they were doing it for their lives. But if you ask Schrader today what would have happened to them if they had missed the steamer—stranded up on the Arctic shores of Northern Alaska—he will give you absolutely nothing but a grin for answer. These fellows with their experiences—great experiences—shut up inside of them, and padlocked, drive the lover of a good story well nigh to madness.

On this trip Schrader went into Alaska from the Pacific Ocean, starting from Skagway with dog sleds and mushing up along the Yukon Valley for a distance of 1200 miles. The musher does not ride on the sled, which is used only for carrying the absolutely necessary supplies and luggage, but tramps beside and urges the dogs forward, or runs ahead on snowshoes to break a trail when necessary. This 1200 miles took the party to the junction of the Yukon and the Koyukuk Rivers, and the next 80 miles up the Koyukuk was by steamer. The next 125 miles was by canoes—a plunge into the unknown—up the John River, a tributary of the Koyukuk, flowing south; then came a five-mile portage over the mountains to the Anaktuyuk River flowing northward into the Arctic Ocean. Down this river the party traveled to the Arctic in canoes, a further distance of nearly 200 miles. This last 300 or more miles was through an untrodden wilderness, and topographic and geologic mapping was vigorously prosecuted en route. The Anaktuyuk empties into the Arctic Ocean in Harrison Bay, and work was continued by canoe 100 miles northwestward along the coast to Smith Bay. Here, owing to stormy

An Alaska pack train accompanying a Geological Survey party of geologists and topographers

weather and heavy surf the Peterborough canoes were abandoned and the ocean journey was continued with Eskimos in their walrus-skin boats as far as Point Barrow, the northernmost part of Alaska, a further distance of 100 miles. Here it was hoped to catch one of the Revenue Cutters or some belated whaler, but when it was learned that all such vessels had gone and that the ice on the ocean was expected to close within a week, an open whale boat and some supplies were hastily procured at Point Barrow and the party pushed with all speed along the coast and made another 400 miles to Cape Lisburn.

"We started on September 5," says Mr. Schrader, "as there was danger of the ice packs being driven in after the wind shifted. Except when prevented by storms for five days we were constantly working toward Cape Lisburn, sailing, rowing, or towing. Finally we sighted the funnel and masts of a steamer lying off the coal beds of Cape Lisburn, which proved to be the 'Arctic,' and we boarded her." No expression of the thankfulness which every member of the party must have felt after the heartbreaking effort—simply "and we boarded her!" Here was a total distance trailed by dog team and canoe of over 2000 miles in a short season when zero winter begins in early September.

For 15 years I have known R. H. Sargent, who mapped part of the Glacier National Park in Montana and has since made many trips into the interior of Alaska. Yet it took a two-months' visit to his surveying camp in the Coast Range of California recently for me to find out a few of his real experiences. Most of them will be buried with him when he dies. He considers them all in the day's work and hardly worth mentioning or remembering.

"Oh, we have had a number of little affairs in Alaska, of course. When the Geological Survey started exploring and mapping Alaska, it was a vast uncharted wilderness, and naturally we couldn't foresee everything. In fact, in many of our trips we did not know anything at all of what was ahead of us. But we always got through all right because, in at least a general way, we were prepared for any emergency. You see, most of the thrilling stories and tales written about superhuman feats and all but insurmountable hardships in Alaska are concerning the performances of tenderfeet or near-tenderfeet. If it were possible to take along a tenderfoot on one of our most commonplace trips he would be recounting the 'experiences' of every day of that trip for the rest of his life. Take, for instance, one day's little happenings up on the Talkeetna River on a raft which probably the other fellows have forgotten all about. The stream is a swift and powerful glacial river and it was then unexplored. We built a good raft to meet all emergencies. Everything of value was tied to the raft, for there were rapids, rocks, snags, and possibly waterfalls. The day's doings included a turning upside down of the raft when it went aground in a swift water, an upsetting of all three men when it struck a submerged rock at tremendous speed, leaving one of them stranded on the rock, and later having two men pulled off the raft by a 'sweeper,' or overhanging tree. One man was swept ashore and the other was 'roped' around the neck by the man left on the raft and hauled aboard."

"Weren't you all good swimmers?" I ventured.

"Swim? Why, man, those glacial rivers with the temperature of ice-water tear along at 9 or 10 miles an hour and suck and swirl like Niagara rapids. The more experience I have with Alaska the greater respect I have for glacial streams and Alaska bears. Only tenderfeet and fools talk flippantly about either."

Bears, as a matter of fact, are rather a sore spot with the Survey men who have been in Alaska. We have been assured so often that the grizzly is a harmless old party who will not bother a man until the man bothers him that we are apt to believe this of all bears. It isn't healthy to believe it of the Alaska species. All the Survey men do not exactly agree that every Alaskan brown bear is vicious, yet they will admit that they are bad customers to rile. One story always struck me as intensely amusing. A Survey exploring party was ascending an interior stream by canoe when they reached a point where the stream divided. Here several of the party, taking their Survey instruments but no guns, left the main stream and ascended the branch, intending to go up the valley 20 or 30 miles and then tramp across and rejoin the other party on the main stream. The branch valley was a narrow one, and after ascending some distance they came to a place where a vertical cliff jutted out almost to the water. Reconnoitering around this cliff they sighted a big bear at a distance of only a few rods, digging for roots and making the dirt fly. The men were down wind so that the bear had no intimation of their presence. They were hardly far enough up the valley to make the crossing desired and the bear was directly in their path, and they had no firearms except one revolver. The situation was somewhat puzzling, but having heard that the Alaskan bears do not like the human voice they decided to scare this one, and so all charged around the cliff in his direction, yelling at the tops of their voices. The bear ran like mad, without even glancing around, apparently scared out of his wits, and the men laughed gleefully at the ease with which he had been routed. After a short distance, however, he appeared to conclude that he had been somewhat hasty and undignified and that he might as well take a look. He stopped, turned around, and it was now the men's turn to feel nervous, as the great brute reared up and up and up on his hind legs, a monster indeed with no indication of gentleness.

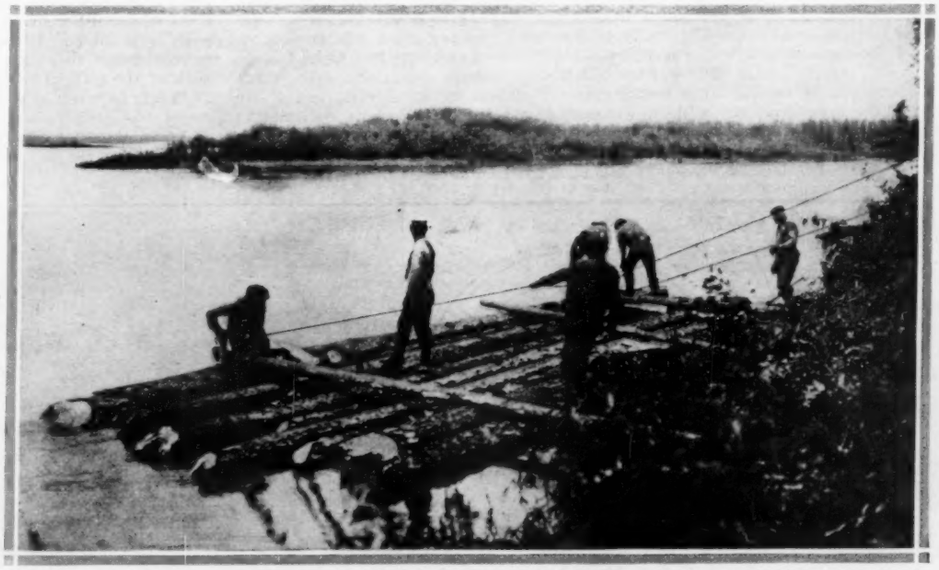
"One look was sufficient, however," said the chief of the party in recalling the incident. "The bear had probably never seen such strange creatures before and he made off again, climbing up over the divide at tremendous speed. We sat and watched him with our glasses and timed him as he raced up hill. When he reached the top of the ridge he turned around and looked at us. While we could see that he was panting, he had taken just 15 minutes to climb 1500 feet in elevation. Being in excellent climbing trim ourselves, we decided to follow his trail, and the best we could do it in was an hour and three-quarters—which shows that there is no use trying to put salt on the tail of a retreating Alaskan bear."

Dr. Alfred H. Brooks, geologist in charge of the United States Geological Survey's work in Alaska, has tramped and canoed over thousands of miles of tundra and along streams in the Territory. If the Geological Survey is not very well known in all parts of the United States, this cannot be said of it in Alaska. Hardly a miner or a prospector in the broad confines of the huge territory but is familiar with the maps and reports of the Survey, which are sent free on application. Brooks was the first white man to set foot on the slopes of Mt. McKinley—before Dr. Cook made his famous ascent (?), by the way. Dr. Brooks and his party did the impossible, according to every Alaskan tradition, advice, and warning, in going in from the coast. His big Geological Survey monograph on the geology of the Mt. McKinley region is stated to be a fine, scientific treatise, but the most interesting part to me is the brief preface in which he modestly recounts the dangers and trials of that trip. When Brooks and his party came out on the other side of the huge mountain—into the Tanana Valley—the Indians thought they had descended from the skies, for no white men had ever before appeared from that direction.

One of the hardest of all Alaskan trips, and considering the shortness of the season, a really remarkable feat, was the ascent by geologist J. E. Spurr in 1898 of the Yentna River, with a good-sized party. Mr. Spurr is a medium-sized, mild-mannered man who doesn't look at first glance as though he were cut out for strenuous things. But the Yentna heads up in the towering Alaskan range and is fed by the great glaciers which sweep down from Mount McKinley, Mount Foraker, and Mount Russell, and it is not a gentle river. Ascending to its headwaters, Spurr's party made a hard, long portage over to the headwaters of the Kuskokwim, and descended this great river to its mouth. The party then traveled in a southeasterly direction alternately following the coast, ascending numerous unknown rivers and making long portages, mapping and studying the geology as they went, finally emerging at Katmai, in Cook Inlet, near the great Katmai volcano. This was a trip of approximately 1800 miles through unbroken wilderness.

At one point the party, traveling in four canoes, was paddling along smoothly in a high meadow stream which suddenly plunged into a narrow, vertical walled canyon. This appeared to extend for many miles. "It will be suicidal," said Spurr, after a brief reconnaissance of the country, "to attempt to run this canyon with the canoes. It's a terror. We'll have to carry around even if it is

(*Continued on page 368*)



Survey men building a raft on the Kuskokwim River in Alaska. The flooring in of dry spruce logs, with cross-pieces fastened by green birch pegs

The Size of a Molecule

By Robert S. Ridgway

THE measurement of gas molecules by a clever method in which the probability of error is greatly reduced is a piece of interesting research work being carried on by Mr. R. B. Brode at the California Institute of Technology. The principle of the apparatus consists of projecting electrons from a hot filament through slits, collecting them at two different distances from the source, and computing the difference in the number of electrons arriving at the two points. The difference indicates the absorption of a space equal to the distance between the two points where the electrons are collected.

H. F. Meyer of Heidelberg used an apparatus which held very rigidly to the description given above when he made his discoveries last year, and his computation for the speed of the projected electrons was made from the potential difference between the plates through which the electrons passed; for a voltage placed at these points, of course, serves to give the electrons the desired velocity. A box served as a collector, and errors from any slight variation in speed of the electron could not be eliminated.

The apparatus which Mr. Brode has designed and which he is using to make his determinations cleverly eliminates this likely source of error in a very simple manner. Since from geometry we know that three points determine a circle, it is then only necessary to make the electrons of different velocities travel in different circular paths in order to select those that have an equal velocity. This is precisely what is done. Referring to the diagram a brass box of about three inches in diameter and three-fourths inch in height is mounted in the glass tube illustrated. An inner wall, G, is placed about one-half inch from the outer wall, and it extends for nearly 170 degrees around the circumference of the box. Pivoted at the center of the apparatus is a small receptacle, A, the conception of which may be more easily obtained from the figure. On the inside of this receptacle is a smaller collector, insulated from the box by amber, and connected to the wire, H, which runs to a quadrant electrometer. In the walls, E, F, and at the indicated side of A are slits through which the electrons pass, and their projection is accomplished as described in the following paragraph.

The box, B, is insulated from the rest of the apparatus, and contains a tungsten filament, which, when heated, shoots off electrons which are accelerated by the voltage applied between the box, B, and the wall, E, the velocity of the electron varying as the square root of the voltage. The cleverness of the arrangement, however, lies in the fact that the whole apparatus is placed inside a large coil, shown in the third illustration, and the magnetic field produced within the coil causes the electrons to follow the desired circular path. From fundamentals of mechanics we know that only those bodies having the same velocity will hold to the same radius, and by collecting in the box, A, those electrons which have already passed through two slits, it is easily seen that they have had the same velocity throughout all their course.

The difference in distance is easily made by having two pegs, *m* and *n*, in the bottom of the apparatus to limit the movement of the collector, A. The box has a cover, on which is a pointer indicating the position of the collector within the apparatus. The bearing is very loose, so that by placing the whole instrument on a hinged table, the collector may be swung from one extreme position to the other (the distance of which is accurately known) by merely tilting the table back and forth.

Knowing this much of the apparatus, it is easy to deduce the practical application of it. The electrons are projected as previously described and the velocity calculated. The box is tilted so that the collector will roll around to the position nearest to slit F, and the electrometer will then register the charge produced by the electrons collected in the box, A. The formula representing this is, $J_t = J_o e^{-\alpha x p}$, where J_t is the number of electrons received within the box in a given interval of time, J_o is the number that have left the filament during the same time, α is proportional to the cross section of the molecules, x is the length of the path, and p the pressure within the apparatus. The collector is then rolled around to its extreme position, and data is again recorded. J_o, the initial charge, conveniently cancels out, all others terms but α are known, and this quantity therefore is easily computed from the formula.

All the apparatus used is shown in the illustration below with the exception of the mercury-vapor pumps which can reduce the pressure to the neighborhood of 10^{-7} millimeters of mercury. The gases are all determined in a like manner by simply admitting the required gas until a pressure of about 10^{-3} millimeters of mercury is attained.

The method is very practical, and should give measurements of a greater accuracy than those previously determined. Comparisons with the results of Ramsauer and Meyer of Heidelberg will be of great interest.

The car, running on rails on either side of the pit, draws the tool under test through the pit while the dynamometer attached records the energy necessary for such propulsion

Testing the Drag of Farming Machinery

IN order to determine the energy required to handle farm implements, the Agricultural College of the University of Nebraska has devised a unique method. A concrete pit, 160 feet long and 12½ feet wide, is kept filled with soil under uniform conditions, over which the implements are drawn by an electric motor car with a dynamometer attached. Besides determining the various adjustments of implements that require the least energy to accomplish the most and the relative pull demanded by the different kinds of implements, the Agricultural Engineering Department hopes to obtain some definite results on the tilth of the soil. The testing outfit for this line of work is the only thing of its kind in the country.

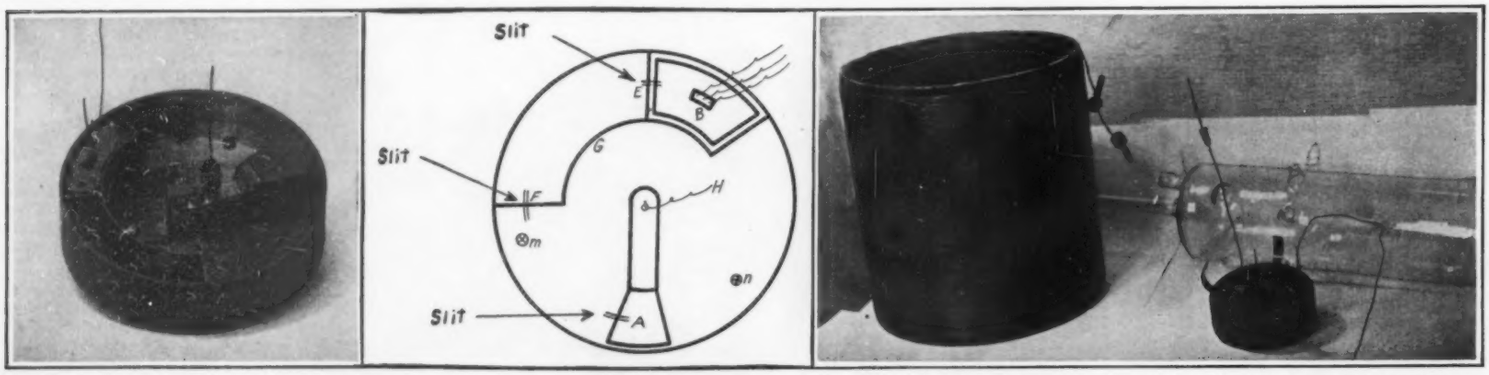
The concrete pit, located in the basement of the agricultural engineering building, is filled with different layers of material in order to secure a porous foundation for the testing soil. The first layer of material is crushed rock, being eight inches in depth. On this is placed the testing soil which is 24 inches deep. It is a mixture of sand and loam. Just enough sand is mixed with the loam to form a sandy-loam which can be worked easily. Each time the soil is worked it is restored to its original firmness by running over it four times with a subsoil firmer and a corrugated roller. When the soil is plowed it has to be plowed back again in order to keep it level. The moisture content of the soil is kept uniform by five water pipes extending up through the bottom of the pit at regular intervals. The flow of water through these pipes may be regulated to any amount desired.

These implements are drawn by a 20-horsepower electric motor supplied with current from an overhead trolley. The motor drives the car through a regular truck transmission, having four speeds forward and one reverse. The speed of this car is from eight-tenths mile per hour to three miles per hour. It runs on rails laid on each side of the concrete pit. The drive-wheels are connected with two cables which are fastened at both ends of the pit. This allows no slipping, giving the machine greater traction. The drawbar to which the implements are hitched is movable and fixed on a graduated base so that the drawbar may be regulated to any position desired. A dynamometer is hitched between the drawbar and the implement to determine the draft. Instead of turning the implement around and drawing it back, it is lifted by a hoist and carried back.

Under the soil conditions on the track, it takes 5 to 7 pounds of pressure to pull a plow in turning over one square inch of soil; that is, if the plow is running one inch deep and cutting a slice one inch wide. An 8-foot disc-harrow required 180 pounds of pressure to pull it when set straight. When this machine is dished or angled to its limit it takes 430 pounds of pressure to draw it. With the addition of a 180-pound weight, the pull is increased to 280 pounds and 640 pounds, respectively. This is the general average, for the draft varies with the depth and rate at which the implement is traveling.

This method of testing has several advantages over outdoor conditions. The soil is not affected by climatic conditions. It is mechanically watered, allowing a uniform moisture content. The soil is not packed by the machine drawing the implements, insuring an even firmness at all times. Under these uniform conditions all implements are given an even and fair test. The draft is more uniform, allowing a more correct measurement of the different tilths.

By this method the engineering department of the college hopes to obtain some definite results on the tilth of the soil. The tilth of the soil is the condition it is left in when plowed, such as dry and cloddy, or moist and mellow, and is believed by soil authorities to be an important factor in crop yields. The tilth of the soil may be determined by the draft of an implement.



Left: Photograph of the box in which the electrons travel. *Center:* Diagram of this box, showing the various parts. *Right:* The whole apparatus-box, coil in which it is set, and discharge tube

Measuring the sizes of molecules by means of electronic discharges

Inventions New and Interesting

A Department Devoted to Pioneer Work in the Various Arts and to Patent News

Both frame and strings of this racquet are of steel, the one of tubing and the other of wire

A Steel Tennis Racquet

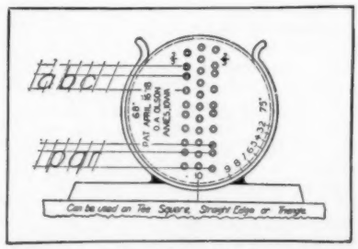
IN this racquet an attempt has been made to get over the old difficulties of broken strings and warping frames by making both frame and strings of steel, which gives greatly added strength and durability, without interfering with weight, accuracy or balance. The frame is of steel tubing, no heavier than the wooden frame, a welded cross member fixing the spread of the throat, while the ends of the frame are deeply and firmly fixed in the wooden handle which is of the ordinary pattern and made to standard sizes. The steel strings are of smooth twisted wire, which, while preserving the tension and resiliency of gut, are practically unbreakable. Gut strings, however, can be fitted if preferred, the holes in the steel frame being made with rounded edges to prevent cutting. No press is required, as the frame cannot warp, nor is the racquet affected by weather conditions. This racquet is the invention of Mr. Wm. A. Larned, who for many years was U. S. champion. The racquet represents extensive experimenting.

The Jack-of-All-Trades

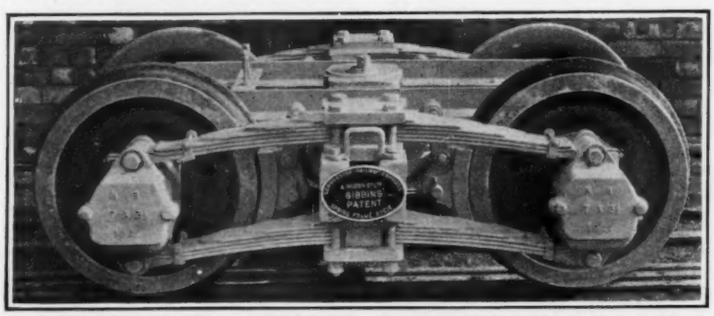
THE general utility tool pictured herewith has been in our hands for some months and has had a pretty comprehensive trial, giving excellent satisfaction. It is designed for use as pliers, pipe wrench, wire-cutter, nippers, etc., etc.; and its range of use is not adequately indicated by a mere catalog of the tools for which it can substitute.

The mode of assembly of the several pieces that make the tool is here the controlling factor. By virtue of a hexagon pin and the corresponding hexagon holes in handle and jaw pieces, each jaw piece has six positions with reference to the handle, and in the bargain each handle has six positions with reference to the other handle. Using the thing as a plain pliers or a plain nippers, one may therefore have the business end of the tool straight out in front, as in a single, unchangeable pliers or nippers; and one may equally turn the business end at an angle of 60, 120, etc., degrees, as is shown in the picture, and this makes it possible to get at many awkward jobs with a minimum of discomfort. Again, one may have the handles as we show them; or one may put a 60- or 120-degree angle between them for the sake of gripping each tightly in a single hand and squeezing with the full force of both arms. Finally, one may do one thing with one jaw and something else with the other. One may, for instance, turn one jaw clear around so that its nipper end opposes the pliers end of its mate, thus obtaining a perfectly good pipe wrench.

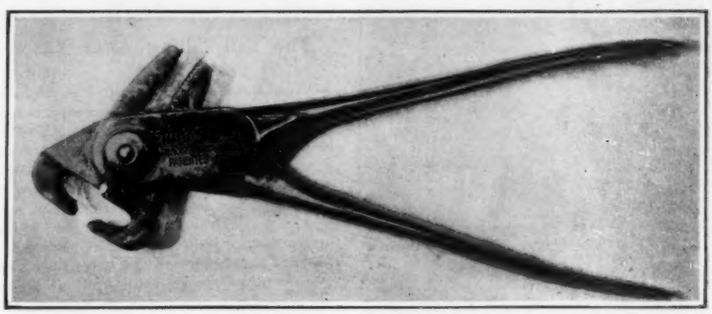
In the base of the pliers end there is just visible, in our picture, a little notch which is a highly effective wire-cutter when the jaws are brought together. Both handle ends are brought to an edge, the one in the shape of a screw-driver and the other as a nail lifter. In its ease of adjustment from one form to another the tool leaves nothing to desire, and it handles like a real tool.



Stencil for drawing guide-lines which possesses an unusual range of utility



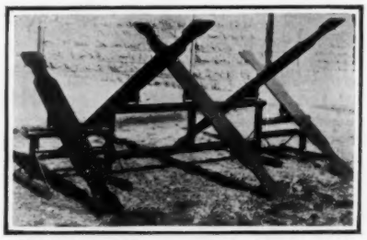
This rail truck has the springs between the wheel and the bolster, instead of between the bolster and the car



One of the very many combinations possible with the latest general utility tool

A "Boughten" See-Saw

THE good, old-fashioned see-saw, which we used to improvise out of a discarded plank and a barrel or tree trunk, is now become an article of invention and manufacture, as the accompanying rather elaborate illustration demonstrates. The single frame carries five teeter-boards; and this frame is so constructed that no digging of holes is necessary in setting it up. The sharp pins on the ends of the four horizontal feet are simply speared into the ground, and that settles it.



Factory-made see-saw that looks and works better than the improvised variety

A Novel Lettering Instrument

NUMEROUS stencils of one sort or another are offered for the use of the draftsman in drawing the guide-lines for his lettering, but few are as complete as the one which we illustrate. Without going too closely into details, we may say that the three ranks of holes and the several possible positions in which the instrument may be laid along the edge of ruler or T-square result in an unusually wide range of spacings. The manufacturers in their circular show how, with a single setting of the instrument on the square, holes are available for drawing three distinct sets of guide lines over the same portion of the paper. At the same time slope-lines of several standard angles can be drawn directly from the instrument.

A Spring-Frame Rail Truck

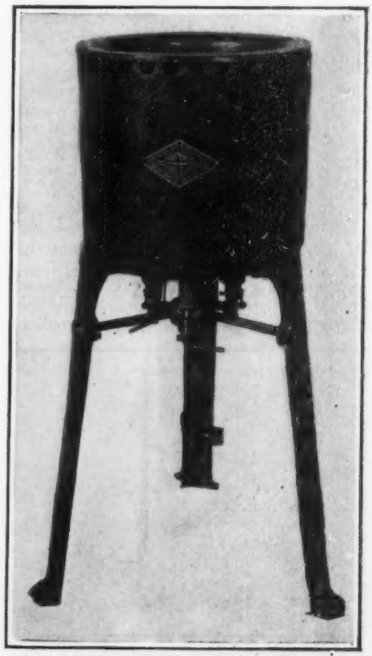
THE object of this design has been to provide a more flexible type of rail truck than the diamond frame; and, as will be seen from the photographs, quite a new departure has been made from the ordinary type of "bogie"— as this piece of equipment is called in England, the home of the present invention.

The idea is to transmit all road shocks from the wheel direct through springs to the truck bolster, instead of through a solid frame as on a diamond type of truck. Two springs are arranged each side, and are attached to the top and bottom of the axleboxes, the bolster being carried in the center. The springs act in a dual capacity, as, apart from taking the load of the body, they work also in a contrary direction, absorbing all road shocks. This arrangement of springing does away with the fixed side frame, the springs taking the lateral and transverse strains, besides being very sensitive to rail joints and track inequalities.

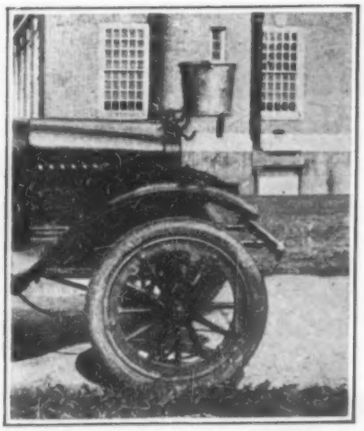
To obviate the possibility of extreme flexibility the springs are worked to a formula which insures a very strong spring with a small deflection per ton, and therefore much stiffer than is usual for safe loads on carriage and wagon stock. The side bearings have been moved out about 8 inches and are arranged direct over the center of the journal, thus considerably eliminating side rolling.

Furnace for Melting Soft Metals

TO meet the demand for a low-cost, medium-size gas-furnace for melting soft metals, a Cedar Rapids, Iowa, house has recently put out the model here illustrated. This furnace stands 28 inches high, weighs 100 pounds, and has a removable cast-iron melting-pot with capacity for 150 pounds of metal. Its three patented atmospheric Bunsen burners are stated to develop any desired tem-



Gas-burning furnace for melting the softer metals



Getting all the water into the radiator

perature up to 2250 degrees Fahrenheit, consuming no more than 40 cubic feet of gas per hour. They have shut-off valves and pilot lights.

The high efficiency claimed for this furnace is attributed to the direct jet regulators in the burners. This regulator, with an orifice that can be instantly adjusted to any pressure or quality of gas, sends a sharp, solid jet of gas up the center of the mixing tube at main pressure, without the use of forced air-blast or blower.

A Guide for the Street-Car Voyager

NO longer need the stranger in town fret about running past his corner, or worry his head over the street at which to alight in order to reach the Globe Theater or the Central Hotel. No longer need he caution the conductor to put him off at Blank Street, and then sit a-fidget, his ears strained to catch the indistinct announcements of that worthy, and his eyes a-quiver to get glimpses of the fleeting street signs. London (England) has recently seen the completely successful trial of an ingenious device for telling the man from another part of the world exactly where he is and whither he is going.

With the new system in complete operation, every surface car would be equipped with a complete map of its route, on a roller at the front of the car. This map would show all intersecting streets; all prominent hotels, theaters, ticket offices, railroad stations, etc., along and near the line, and would of course automatically indicate where one should get off to reach each of these places. It would show intersecting lines and transfer points, with a brief summary of the points of interest attainable by transferring. It would, in a word, show all the things for a knowledge of which the stranger in town must now rely upon the conductor, corrected and amended by the well-meaning old gentleman in the next seat.

Such a map, on a sufficient basis, would, of course, be too long by far for display in one section. It is therefore rolled on a roller, which is geared to the car motor or to the wheels in such a way that it unrolls just fast enough to keep pace with the car. The final touch is given to this very handy device by the arrow at the bottom of the visible portion of the map, which in effect says "You are now here." The installation of this guide marks at least one place where Britain has stolen a march on Yankee ingenuity.

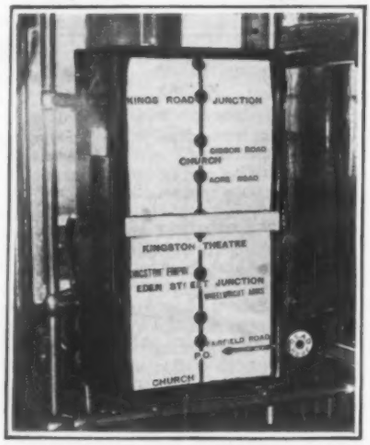
Neat and efficient home-charger for radio work

The Self-Filling Auto-Water Bucket

EVERY automobilist who has oil filled into his crank-case at garages and service stations is familiar with the clever little quart and half-gallon measures provided with a flexible spout which can be raised to keep the oil from flowing, or lowered to cause it to flow. Somewhat the same principle has now been applied by Mr. Randolph Smith of Baltimore to the filling of water into the radiator—a job whose slop, perhaps not quite so annoying as that of filling oil, is none the less present and annoying. Mr. Smith's specially fitted bucket sits up on the bracket shown in the illustration and puts all of its water by way of the flexible connection right into the radiator where it is wanted, instead of spilling it where it is not wanted. No more effective than a funnel, perhaps; but a funnel is an additional piece of apparatus, in the presence of the bucket which must be used in any event, and one which may very well be dispensed with as Mr. Smith dispenses with it.

Home Charging of Radio Batteries

BEAUTY is combined with utility in the new radio home-charging outfit illustrated herewith, for use with "A" and "B" batteries. Finished in mahogany and old gold, it harmonizes with the finest room fittings, and permits the radio enthusiast to recharge his battery after an evening's entertainment, without even disconnecting it from the set. Its working parts are entirely enclosed, eliminating all danger of shock and fire. It is self-polarizing, so that the batteries may be connected either way and will charge. It gives the tapering charge recommended by battery manufacturers. It will fully charge any "A" or "B" battery overnight at a cost of a few cents in commercial current.



Traveler's guide that keeps pace with the car in which it is mounted

Cleaning Steel Billets with a Hot Scraper

A MECHANICAL invention of wide importance and use to the steel industry has been perfected by a Canadian engineer. Although it has been in use over two years in a Canadian steel mill, no publicity regarding it has been available until just recently. The device is known as a hot billet scraper.

In steel-rolling mills all steel is run through rolls from the original large ingot as cast so as to break it down or reduce it to a smaller size. The smaller sizes of various dimensions are called billets.

In regular practice, without the use of the new invention, all such billets have in them and on them certain defects caused by the rolling and pressing down of the hot steel. These defects consist of seams, slivers, holes, dirt, etc. To remove them it is necessary to employ a force of men which spends much time in going over each billet and removing such defects by means of chipping hammers. The space occupied for such an undertaking is also large and an important item. The whole job of inspection and cleaning involves a large expense and an increase in cost to the steel consumer.

Scraper for hot cleaning of steel billets

The new mechanical device or hot billet scraper is intended to do away with all such work. The scraper itself removes all defects while the steel is being rolled. Two of these scrapers are located near the last set of rolls and the hot steel passes through them. Knives of stellite in the scrapers cut off from the hot metal any loose or adhering metal, oxide or dirt and the billet when completed is clean and almost perfect.

The illustrations give an adequate idea of the mechanism and its work. It comprises two sets of scrapers designed to engage the surfaces of the passing billets at whatever pressure may be required to remove flaws, means being provided also for automatically guiding the billets to the scrapers. Pressure is applied independently to each scraper blade, each machine having four cylinders, two of which operate horizontally and two vertically. The apparatus may be operated under air, steam or water pressure and is so designed that the pressure on each side is subject to separate control. The automatic operation of the scrapers is provided by means of a bar, so connected and positioned that the passage of the billet trips it, thereby actuating a valve which controls the operation of the cylinders. Thus in entering the scraping device the billet automatically sets the blades against the steel at a preadjusted pressure and on leaving releases the trip lever which automatically retracts the scrapers.

One Handle, Many Blades

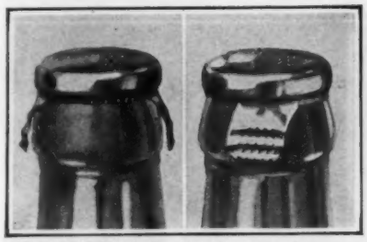
THE average citizen, asked to slice bacon with a bread knife, would doubtless either give it up as a bad job or make a thoroughly bad job of it. But the man equipped with the combination knife illustrated, with its detachable blades, is subject to no such embarrassing choice. This knife consists of a wooden handle, quite according to rule; and a metal shank, which looks for all the world like a narrow blade save for the fact that it has no edge. To this shank is clamped any particular one of a considerable assortment of special-service edges—wavy edges for bread, sharp thin ones for bacon, dull thick ones for butter or cheese, and so on to the full extent of the purchaser's desire. The labor of detaching and attaching the blades is insignificant; the saving in handle expense is notable.

Knife with a variety of detachable blades for various purposes

Adjustable Ratchet Wrench that Works Like a Pliers

NUMEROUS wrench makers of late have put out tools intended to give recognition to the fact that when an ordinary adjustable wrench is adjusted to such size that it will grip a given nut firmly and turn it without slipping, it is a matter of more or less difficulty to wrap it around that nut, and sometimes is a matter of even more nursing to unwrap it. The latest attack upon the problem is doubly pleasing in that it is a full ratchet wrench, and has to be engaged and disengaged with the nut but once. This is of course a particular advantage when the nut is a misshapen one that does not measure the same on all flats. In addition to the ratchet feature, it is a full-blown monkey wrench, of the type having the adjusting screw across the handle and the jaw-opening at the extreme end rather than along the side. But the real trick comes when we learn that the two arms by which the hand grips the wrench work like a pliers handle. In adjusting the jaws, it is not necessary or even desirable to adjust them closely to the nut size. They are to be brought to an opening comfortably larger than the nut size, and then put over the nut. Pressure on the handle now brings the spring into play and the jaws close down on the nut, gripping it in a bulldog embrace

A wrench of all work possessing outstanding advantages



The soft-drink bottle that can be unsealed with the unaided fingers

that will not let go until the user of the wrench lets go himself.

The manufacturers point out that because of the pliers-like action of the wrench handle, it is in fact, besides being a highly satisfactory adjustable wrench, also usable as pliers, nail puller, pipe wrench, nutcracker, etc., etc.

Paint Helps Sell a Used Car

THE man who is trying to sell a used car should always remember that the purchaser is more interested in the general appearance of the car than he is in the mechanical units. A coat of paint or a little touching up and varnishing will do more to sell a used car than all of the talk that the seller can think up. Instances have been known where $50 or $100 more was obtained for a car that had been painted and some small but desirable equipment added that was not provided in the first place.

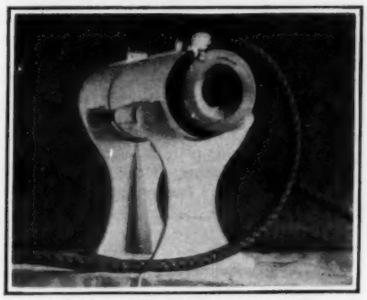
A Novel Landing Carriage

THE retractable wheeled chassis for taking off and landing an airplane is nothing particularly new. So little cannot be said, however, of a combination of wheels and skids devised by Lawrence Sperry, son of the inventor of gyroscope fame. The younger Sperry points out that where wheels are in practically every instance the desirable means of taking off, landings frequently must be made upon fields so rough that the wheels present grave danger of capsizing. Under these circumstances skids offer much greater stability. So Mr. Sperry has designed the curious looking gear pictured, in which we have both wheels and skids. The wheels are, of course, retractable to minimize air resistance; but this is not necessary with the skids, as these are of relatively stream-line shape in any event. The skids are connected with the plane body by very heavy springs, so that almost any imaginable shock from a landing other than an actual fall will be taken up without damage.

Wheels and skids combined in a landing carriage

The Bottle That Needs No Opener

EVERY consumer of bottled soft drinks has had at least one struggle with the conventional cap or seal which must be removed to get access to the contents of the bottle. This of course comes off easily enough in the presence of the appropriate tool for its removal; but it needs no extensive study of the "eternal cussedness of inanimate objects" to convince one that the tool is very likely to be missing at the moment when it is wanted. Some more or less unsatisfactory expedient must then be employed; and a sufficient indication of the poor character of this expedient is given by the statement of a leading hotel, that it costs $1500 per year to repair the damage done by guests in attempting the removal of bottle seals in



Device for cooling light from ordinary hot sources

bureau drawers, door jambs, beneath window sashes, and wherever else it appears that a leverage may be got.

A New York concern [illegible] on the market with a seal for bottles that eliminates all this. The seal is manufactured at the moment of application to the bottle, from a strip of aluminum. The sealing machine cuts this out, inserts the cork or paraffined paper disk to keep the liquid from contact with the metal, and puts the ensemble on the bottles as the latter come from the filling machines at a speed of 5000 per hour. The seal requires no opener, but is simply torn off by means of the flaps. In spite of this it is so applied to the bottle that it will withstand gas pressures up to 90 or 100 pounds.

Cooled Light

LAST month there was related in these columns the manner in which Professor Harvey of Princeton has been seeking "cold light," that dream of ages, from biological sources. Now we have to chronicle the attack upon the problem from quite another direction made by Max J. Ritterrath of Los Angeles.

We know that the radiation from the sun or from any other incandescent body contains waves of widely varying lengths. The shorter ones affect the eye and are light. The longer ones are ordinary radiant heat. Light is hot because we invariably produce it by raising some body to incandescence; and under these conditions, inevitably there must be given off not alone the desired light wave-lengths, but likewise radiant-heat wave-lengths corresponding to the temperature of the radiating body. Mr. Ritterrath proposes to eliminate these from the ray before we use it.

This sounds simple enough, but it has taken the inventor some years to find a way to do it. The device which he is now marketing operates by a sort of selective refraction. It passes the combined light and heat wave through a spiral stream of water in such a way that the infra-red rays—the heat rays of long wave-length, that is to say—are diverted to the edges of the beam and then absorbed by the running water and their heat carried off. Outwardly the apparatus looks like a short hollow pipe with two hose connections on one side, and a supporting base. The water flows spirally through this apparatus.

As the light strikes the water, upon entering the machine, the infra-red rays (from which the heat of light comes) are naturally on the outer edge of the beam. This coming in contact with the water refracts them and the flowing water carries the heat away. The light, thus deprived of its heat element, goes through the machine and comes out cold.

Ritterrath hopes to be able to do away with the flowing water shortly, through a fluid upon which he is now working. When perfected, this will be sealed inside the machine; refraction accomplished by glass; and the heat absorbed by the fluid. Other similar improvements are also under way and the process is no doubt still in a very infantile state. The fact that it is able to produce real "cold light," however, is the main achievement and the improvements are merely secondary.

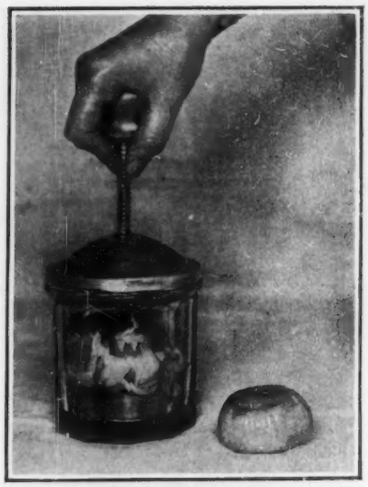
By way of demonstration, the inventor recently passed a 30,000-candle-power beam of light from six motion-picture projectors, working as one, through a strip of film. Ordinarily the heat in the beam from one projector is such that a stoppage in the mechanism resulting in the film's remaining at rest in the beam for 3½ seconds heats the film to the combustion point. In this demonstration the combined beam was focussed upon one point of the film for an hour—and nothing happened. This looks altogether like cold light!

Any Camera a Stereoscopic One

EVEN in this day of new wonders, old wonders do not go out entirely; and many of us find the stereoscope, that uncanny instrument for making pictures leap out into three dimensions and come to life before our eyes, still of interest. But the stereoscope has always suffered from the limitation that one must either confine oneself to the pictures offered by the maker of the instrument, or purchase an expensive and complicated stereoscopic camera in order to be able to make them to one's own pleasure.

Making "association" records in the home

William Prucha of San Diego, Calif., has recently invented a clever though extremely simple "stereoscopic adapter" to remedy this situation and make every tripod camera a potential stereoscopic instrument. The adapter consists of a sheet-metal base-plate for the camera, with two positions in which the box can be fastened—one at each extreme of right and left. This plate is secured upon the tripod just as the camera itself would be secured; and then the camera is in turn mounted on the adapter. Two exposures are made, one with the camera in the extreme right-hand position permitted by the adapter and the other from the extreme left. The two negatives are then related to one another in exactly the correct way to be used together as stereoscopic views.



Chopping onions without tears

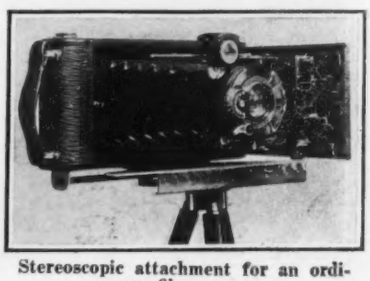
Keeping the Onion Odor Inside

THAT most delightful of all vegetables, after it is ready for the table, cannot well be prepared, either for consumption on its own merits or for use in seasoning other dishes, without bringing tears to the eyes of the unfortunate cook and diffusing its odor throughout the house. But with the apparatus shown here, all this is changed. The plunger is worked up and down in the sealed glass jar, and the onion is cut and minced in preparation for cooking. The same device can be used, though without quite the same olfactory advantages, for chopping fruits and nuts of all kinds. The cutting knives on the end of the plunger revolve slightly as the plunger moves up and down, insuring in this way a good job of slicing.

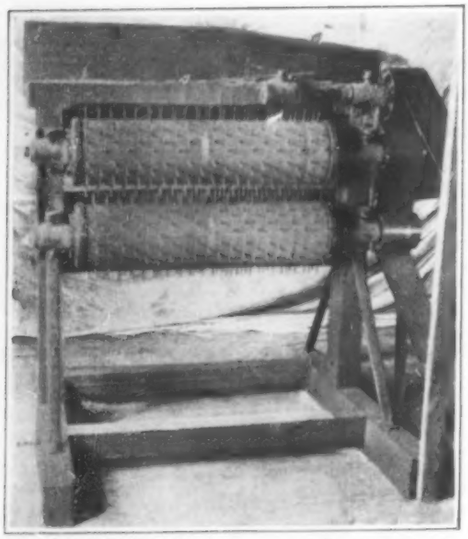
Personal Phonograph Records

ATTACHMENTS for the phonograph are legion—almost as plentiful, in fact, as those for the automobile; but few display the promise of permanent value to be recognized in the one illustrated herewith. This is nothing other than a metallic recording disc, of a plastic alloy soft enough to receive the impression from the needle, yet resistant enough to withstand the attack of a fiber reproducing needle. The disc in question is intended for the making of records in the home, and it is suggested that in time this may come to be as much standard practice as in the making of one's own pictures.

Certain precautions have to be taken in this connection, some of them by the maker of the apparatus and others by the user. The recording disc comes already provided with a volute spiral groove, just like the regular record but perfectly smooth. The needle follows this groove in making the record, and its lateral vibrations leave the necessary wave-track. The average person, in articulating a full sound like the vowel "Ah" will cause the recording point to exert a pressure of about 75 pounds on the tiny bit of the record with which it is in contact. This is millions of pounds per square inch, and there need be no



Stereoscopic attachment for an ordinary film camera



Threshing machine for broom corn, that discards the seed and saves the straw

Reversing the Order of Threshing

BROOM corn, a cultivated crop from which brooms and brushes are manufactured, has to be threshed in much the same fashion as wheat and other grain. In the case of the broom corn, however, it is the brush and not the seed that is valuable. The latter has to be divorced from the bushy growth in order that the adage—"A new broom sweeps clean"—will not lose its cast.

Obviously, removing the seed by hand would be too tedious and slow of accomplishment. Consequently, a machine has been built for the exclusive purpose of separating the seed from the broom material proper. Two horizontal cylinders, one three inches above the other, are not harmonious in action—that is, they revolve in opposite directions. Their surfaces are spiked, the teeth projecting themselves one and three-fourths inches from the surface. They are set three inches apart in rows one inch apart, running lengthwise of the cylinders. The spikes alternate in the rows running lengthwise, so that the rows around the cylinders are formed by the teeth of alternate rows running lengthwise.

The machine is hand fed, the operator standing immediately in front of the cylinder. The brush of the broom corn is seized firmly by the stems at the base and the tips are inserted between the cylinders and held there until the seeds are removed. Forthwith the embryo broom or brush is withdrawn. The efficiency of the machine is reckoned by its capacity for removing all the seed and yet retain intact the fiber. Like the fox, it is the brush that counts in the growing as well as harvesting of this member of the sorghum family.

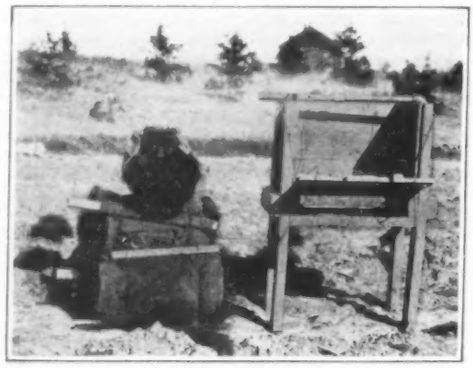
Beet-Top Silage in the Ground

SCIENTIFIC practices which have proven the merits of beet-top silage, a by-product of the beet-sugar industry, as a succulent feed for sheep, dairy and beef cattle have likewise determined the utility of the earth silo in preserving the hitherto discarded leaves and crowns of sugar beets. Idaho and Utah alone are capable of yielding 400,000 tons of tops annually.

Pit silos for storing the tops and crowns vary in details of construction, but the principle employed is the same. One type of earth silo, long and deep in dimensions, is ten feet wide at the bottom. The soil is preferably of a stiff clay, insuring substantial sides. Where the land is sandy, the dug-out is reinforced by concrete retaining walls; otherwise, the soil and silage may form a disagreeable admixture. After the tops and crowns have been deprived of adhering dirt, a fork serving the purpose, they are assembled in 100-pound piles. A flat-top rack on a low-wheeled wagon is an ideal conveyance for transferring the tops from the field to the silo. The loaded wagon is driven through the pit silo, the tops then being scattered and packed in mother earth's container. Sloping ends of the silo facilitate the unloading in this fashion.

Where the soil can be drawn against the sides it is firmly packed where the tops are heaped above the surface earth or retaining wall. Free air is altogether excluded. Once the tops have been thoroughly tramped, frequently accomplished by a boy riding a horse over the material, the pit is sealed as nearly air-tight as possible. Chaffy straw, laid to a depth of eight or ten inches, is considered effectual in purpose. Not infrequently is a thin layer of straw placed on the tops and the whole mass of material submerged in twelve inches of earth.

The United States Department of Agriculture recommends the feeding of beet-top silage at a ratio of thirty pounds to the 10,000 pounds of weight for cattle and three pounds per head for sheep each day. In producing beef or mutton, an allowance of beet-top silage will reduce the hay requirements by half. It is not a balanced ration and must be supplemented with alfalfa and possibly concentrated feeds.



Baling baby trees for transportation from the seed-bed to the permanent plantation

This trench, located on a well-drained hillside, serves admirably as a silo for beet-tops

A Circular-Saw Stump-Cutter

ONE of the simplest of stump pullers is that invented by L. S. Adams of Webster Grove, Mo., and illustrated herewith. It is built on an open iron frame and is moved about on three broad tread wheels. The saw itself consists of a circular band of special stone-cutting steel, five-eighths of an inch thick and eight inches in width. The machines are manufactured in two sizes, having saws eight and twelve feet in diameter, respectively. This saw is operated by a small gasoline engine from which the saw blade may be released or reengaged at will, by a hand clutch. The transmission of power is chain drive. The pressure and direction of the cutting edge is controlled by a crank and set of gears so that the operator may control it as he likes. This saw will take care of any stump up to eight feet in diameter.

The machine is guided and supported in front by a pivot wheel and is drawn up to a stump so that it passes by the pivot wheel and under the side of the triangular wheel. The machine is then wheeled toward the side the stump entered, thus placing it directly in front of the saw blade. The saw is then engaged with the motor and does its work.

Dam for making artificial freshets when the lumberman needs them to move his logs

The Lumberman's Artificial Freshet

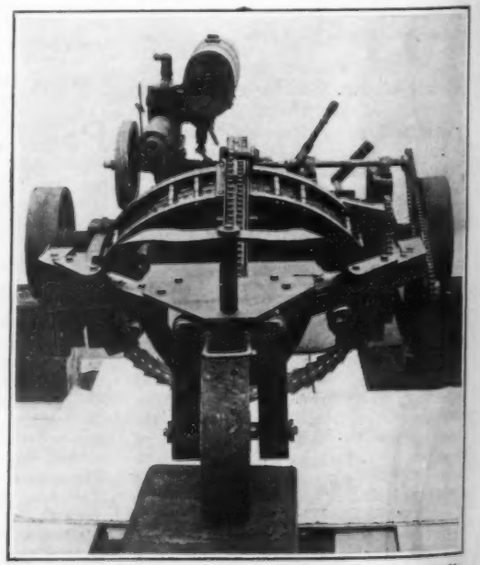
THE good old-fashioned procedure of floating the logs down the stream on the bosom of the freshet is familiar to us all; but when there is no freshet, what then? A lumberman in northern Michigan supplies the answer: When there is no freshet, he makes one! We illustrate the log dam by means of which he accumulates water for this purpose, and we recommend the artificial freshet to lumbermen generally.

Baling Trees

IN the reforestation of the National woodlands, the United States Forest Service maintains nurseries for reproducing trees in much the same fashion as plants and fruit trees are propagated. The location of the seed bed may be far removed from the denuded forest where the baby trees are to be transplanted. A tree packer or baler, designed especially for the purpose, is the connecting link between the seed bed and the forest.

The frame of the packer is constructed of dressed lumber, bolted together with carriage bolts. The principle of the device is the capstan. Two one-eighth-inch holes are drilled in a piece of three-fourths-inch pipe 32 inches long at 13 inches apart, equally distant from either end. The pipe lies on top of the tree packer. A crank is attached to one end, two short lengths of pipe and elbows serving the purpose. Two pieces of 1¼-inch strap iron, each 8 inches long, are loosely riveted together at one end as a sort of hinge. A hole is drilled in one end of the hinge in which is fitted a 32-inch length of pipe. The other end of the hinge is fastened near the back of the box, this end of the hinge also moving freely with a bolt as a pivot. The opposite end of the pipe is not fastened, lying unhampered on top of the packer. The pipe facilitates the bundling of any sized package of trees.

A tool resembling a wagon hammer serves as a twister for insuring a compact bundle. In fact, it is a wrench with jaws 16/17 inch apart and 2½ inches long, fitting over the twisting strip which is two inches wide and one inch thick. The handle is 15 inches long. The baling frame is of two strips of wood, 1 x 2 x 24 inches, fastened with poultry netting staples to the baling wire. The completed packer can accommodate from 6000 to 7000 Western white pine seedlings.



This stump-cutter saws the stump through well below the surface, and removes it with a segment of the ground

The Motor-Driven Commercial Vehicle

Conducted by MAJOR VICTOR W. PAGE, M. S. A. E.

This department is devoted to the interests of present and prospective owners of motor trucks and delivery wagons. The editor will endeavor to answer any question relating to mechanical features, operation and management of commercial motor vehicles

The Gasoline Rail-Car

RAILROAD officials, having become much interested of late in the gasoline-propelled railway-car, were given the opportunity recently of inspecting one of the latest and most improved cars of this type, which was run over the Pennsylvania Railroad from Philadelphia to Washington, a distance of 136 miles. The car made the run to Washington for the annual meeting of the American Short-line Railroad Association and was the feature exhibit at the convention. It made daily runs during the convention over the tracks of the Washington & Old Dominion Railway, carrying as passengers representatives of the various short-line railroads in attendance at the meeting. While a number of short-line railroads have been operating gasoline rail-cars successfully for several years, it is only recently that the gasoline car has come to attract wide attention on the part of railroad men, not only operators of short-line railways, but officials of some of the country's largest transportation systems. Developments in the rail-coach are being watched with the keenest interest by railroads, and the run from Philadelphia to Washington attracted numerous prominent railway officials as passengers.

The rail-car operated to Washington was built for the Union Transportation Company and is now operating over the company's 25 miles of track between Pemberton and Hightstown, N. J. The Union Transportation Company placed a 29-passenger rail-car in service with such success that a second car of larger capacity was purchased. The larger car —the one used on the demonstration run —has a seating capacity of 41 and a baggage compartment directly in the rear of the driver, who controls the car from the right-hand side.

The body, which is of semi-steel construction, is mounted on a specially designed rail-car chassis. There is a four-wheel pivotal truck in front and two wheels in rear. It is governed to a speed of 33 miles per hour. This speed was maintained with ease on the run to Washington. The satisfactory performance of the car both on the runs over the Pennsylvania and over the Washington & Old Dominion Railway from Washington to Great Falls, Va., much impressed the railroad men.

The trips over the Great Falls division of the Washington & Old Dominion were considered a severe test for the car, as the road is a succession of grades running as high as 3½ to 4 per cent and the curves to 10 degrees, with a frequent combination of both grade and curve. The grades were negotiated with ease and a fair speed was maintained even on the most severe ascents. To demonstrate its reserve power the car on numerous occasions was brought to a stop when midway up a grade and again started. It accelerated readily and continued to top of grades without difficulty. This was true in both forward and reverse. Refinements embodied in the latest type of rail-car make riding exceedingly comfortable. It has been the experience of the Union Transportation Company that passengers prefer their gasoline rail-car to their steam trains.

As previously stated, railroads are watching with keen interest developments in the gasoline rail-car, recognizing that equipment of this type offers an opportunity of better serving the traveling public and at a cost far below that of steam-train operation. Railroad men are pretty well agreed that the expensive part of the railroad business is the running of thousands of miles of unprofitable passenger service on light branches or light portions of main lines. Once established, it is a difficult thing for the railroads to curtail such service even though it be unprofitable. With recent improvements in the rail-car before them, railway executives are alive to the situation and are now genuinely interested in the possibilities of the rail-car as a solution to the problem of being forced to operate passenger trains where business does not justify doing so. They are convinced that the rail-car, because of its light weight and low first cost, coupled with simplicity in operation and maintenance, is worthy of serious consideration.

Forty-one-passenger gasoline rail-car of one of the very latest designs

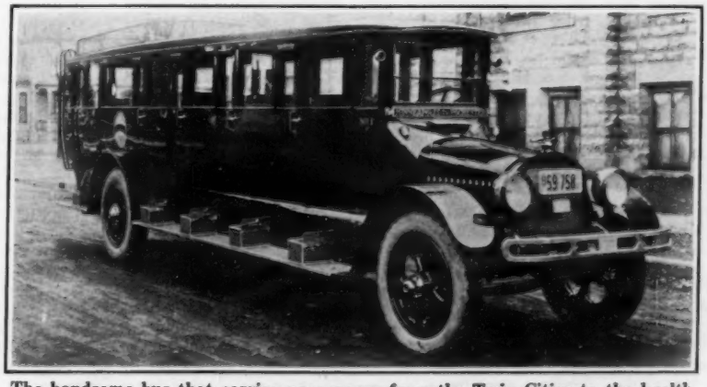
Buses De Luxe to the Surgical Mecca

ROCHESTER, Minnesota, is the location of the most famous surgical institution in America, if not in the world. From all over the earth sufferers come to the Mayo Brothers for surgical attention. Rochester is 90 miles from Minneapolis, and up until recently the only means of transportation has been either the local trains on the railroad or hired automobiles. To provide the privacy and ease of the former and to eliminate the necessity of a taxicab ride at either end, there has been established a de luxe line, running from the Curtis Hotel in Minneapolis and the St. Paul Hotel in St. Paul to the Kahler and Zambrota Hotels in Rochester. While Mayo's sanitarium is the chief attraction in Rochester, the line also serves those traveling between the two points for other reasons. The first of the buses, illustrated herewith, recently placed in service, is of the multiple limousine type, having five compartments, separated by glass partitions and provided with individual doors on each side. They are carried on large pneumatic-tired bus chassis, the ease of riding being enhanced by unusually long springs and rubber shock insulators between the spring ends and the frame, thus eliminating the ordinary rigid spring shackles and substituting therefor blocks of live, resilient rubber.

Four of the five compartments are for passengers, the fifth being for the driver, with one extra seat for a passenger. Three of the remaining compartments are exact duplicates, being provided with deeply-cushioned divan seats accommodating three passengers each. The last compartment is larger than the rest, having rotunda seating for nine, being used as a smoking compartment. Easy ingress and egress for each compartment is provided by the unusual width of the doors and by auxiliary steps carried by the running boards. Each compartment is equipped with an effective ventilator on each side which can be controlled by the passengers to just the amount of fresh air desired, without affecting the ventilation of the other compartments. Similarly the heating system is individual, each compartment being provided with a register in the floor which communicates with an air jacket about the exhaust pipe.

The body is enameled a deep blue, with chassis painting to harmonize. All seats, except those in the smoking compartment, are upholstered in gray striped velour laid over genuine leather, the ceiling, window posts and carpet seat backs being finished in harmonious material. The smoking compartment is upholstered in gray leather. The cushions are provided with compound springs and real curled hair padding. A large baggage rack is provided on the rear portion of the roof, having a wire mesh railing and leather-covered steel straps, extending from front to back to hold the baggage down snugly. A tarpaulin cover fastens down firmly over this to protect it from dust. This upper deck is reached by a ladder at the rearmost portion of the right side. Space for hand baggage is provided under the rear seat, a locked door at the rear giving access.

The present bus makes one round trip each day, the roads being good travel, straight and level. The trip requires 4½ hours and is made on fixed schedule. The fare is $5 each way, only a few cents more than the regular first-class railroad fare. All seats are numbered and reserved in advance, so that the first purchasers of tickets are assured of their choice of seats and no jostling to secure the best seats takes place. An unusual feature of the service is that each ticket carries complete casualty insurance, the ticket being divided by perforations. On boarding the bus the passenger surrenders half of the ticket to the operator and retains the other half as an insurance policy.



The handsome bus that carries passengers from the Twin Cities to the health city of Rochester, Minn.

Operating Conditions of Truck Motors

AUTHORITIES state that the power plant of a motor truck will have a piston speed of two or three times that of a similar engine used for passenger car propulsion because of the low reduction gear ratios necessary to drive a heavy truck with an engine of reasonable piston displacement. A truck engine operates under heavy-duty conditions practically all of the time and it should be specially built for the work. All bearing surfaces should be larger than in a pleasure-car motor of the same power, the lubricating system must be positive, and the water cooling is usually by forced circulation in which a pump keeps the water moving. An interesting comparison may be made between a truck and a passenger-car engine of 300 cubic inches piston displacement to show how truck engines must be run faster. A passenger car with 4.25 to 1 reduction and 34-inch tires will require an engine speed of 750 r. p. m. to attain a vehicle speed of 15 miles per hour. A two-ton truck with 36-inch tires and 8.5 to 1 drive axle reduction would necessitate an engine speed of about 1400 r. p. m., or 650 r. p. m. more than the pleasure car to attain the same speed. Unless specially designed for high-speed work, the normal crank-shaft speed of a motor truck power plant should not exceed 1000 r. p. m., to secure long life of bearings and other engine parts.

The Heavens in November, 1922

Something About Planetary Heat Emission and Temperatures

By Professor Henry Norris Russell, Ph.D.

THESE lines are written upon the return from the meeting of the American Astronomical Society at the Yerkes Observatory, which has brought together nigh on a hundred students of the stars from all over the country. It has been a very successful meeting, with a larger attendance, and an unusually long list of scientific communications—more than sixty titles appearing on the program, and about fifty being actually read at the scientific sessions. The hottest weather of the summer made surprisingly little difference in the attendance upon these, although it may be mentioned that during a discussion on planetary temperatures, one afternoon, our distinguished host, Professor Frost, rose with the relevant information that the temperature of the earth's atmosphere, at that immediate time and place, was slightly over 100 degrees Fahrenheit. Among the many announcements of recent work, only a few can find place in our narrative here, and many admirable papers, of more technical character, must pass without mention.

From Mount Wilson come, as usual, some good things. Van Maanen has found three more cases of motion in spiral nebulæ—outward along the arms, as in the examples previously known. Adams and Joy have extended the spectroscopic method for determining parallaxes to the stars of spectral class A, which were previously intractable. The results are beautifully simple. Some of these stars have very wide and hazy lines in their spectra, and others fairly sharp lines. The latter are almost invariably brighter than the former—a statement which refers, of course, to their real brightness, or absolute magnitude; but the stars with sharp lines, or those with hazy lines, are so much like one another in brightness that the observations hardly suffice to reveal any real differences. If we know the exact spectral type—A_2, for example, or A_6—and whether the lines are sharp or fuzzy, we can at once estimate the star's real brightness closely enough to get a good value of its distance. In this way the parallaxes of more than 500 stars have been deduced—a most important addition to our knowledge of stellar distances. Some exceptionally bright stars, such as Alpha Cygni, and a few faint "dwarfs," are reserved for future investigation.

Michelson and Pease report further work on stellar diameters with the interferometer. The angular diameters of Arcturus, Aldebaran and Beta Pegasi are all close to 0.016 seconds, which would make the actual diameters about 20,000,000 miles for Arcturus and 30,000,000 for Aldebaran. For even the brightest white stars, however, the diameters are too small to measure. A short letter from Hale described the plans for a greater interferometer, of 50 feet span, which is soon to be constructed, and which will extend the investigation to a much greater number of stars.

Heat from the Planets

From the Lowell Observatory comes some very interesting work by Coblentz (of the Bureau of Standards) and Lampland on the heat radiation of the planets. With a very delicate thermocouple they have measured the heat sent us from these, and the percentage of this heat which is absorbed in passing through a cell containing water.

The importance of the water-cell is this: the heat which we receive from the planets is partly composed of reflected solar heat and partly of heat which has been absorbed by the planet's surface and reëmitted. Now the sun's heat, coming from a very hot body, is of short wave-length and passes through the water-cell with but slight loss. The heat radiated from the body at moderate temperatures, such as that of boiling water, however, is of long wave-length, and is stopped by a water-cell, though most of it gets through the earth's atmosphere. A colder body (say, below the freezing point) still emits some heat, but mainly in waves so long that the atmosphere easily stops them.

We can now understand the results of Coblentz and Lampland. They find that about 69 per cent of the sun's heat passes through the water-cell and almost exactly the same percentage of the heat that we get from Jupiter and Venus does so. Only 50 per cent of the heat from Mars gets through the water, and only 15 per cent of that from the moon. It follows that all the heat we get from Jupiter and practically all from Venus is reflected sunlight. In the case of Mars about 30 per cent of what we get represents heat radiated from the planet itself, while for the moon this proportion is 80 per cent.

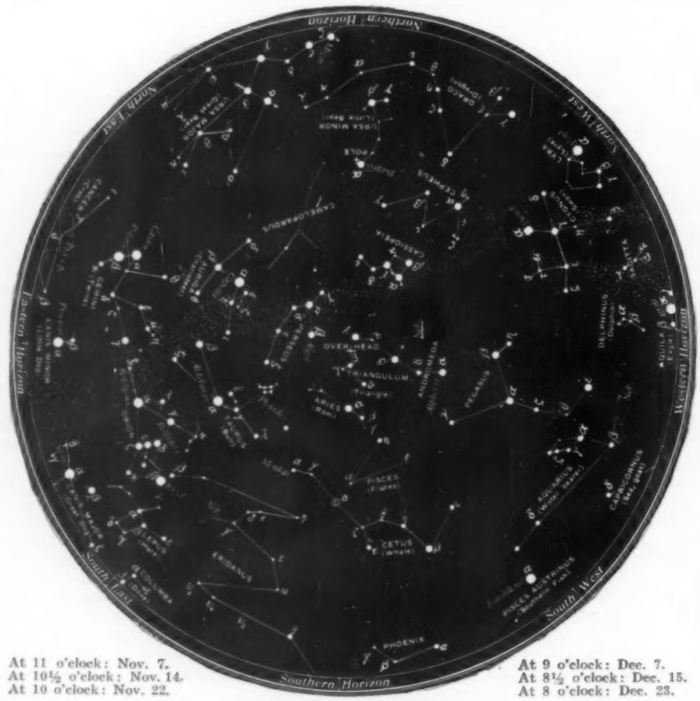
Problems of Temperature

Now all the heat which a planet does not reflect must be absorbed and reradiated. Taking the known reflecting powers of the planets, we find that the latter component of the total heat should be about 90 per cent of the whole for the moon, 70 per cent for Mars, and 40 per cent for Jupiter and Venus. By comparing these amounts with those actually observed, we find that almost all the heat radiated by the moon gets through the atmosphere to our instruments, while in the case of Mars only about one-half gets through and from Jupiter and Venus practically none. This indicates that the moon's surface (on the sun-lit side) must be fairly hot, that of Mars colder, and those of Venus and Jupiter very cold. Except for Venus this is what might be expected with increasing distance from the sun. The case of this planet is remarkable. She gets twice as much heat per square mile from the sun as the earth does, and, in spite of the high reflecting power, retains more. But the apparent paradox may be explained by assuming that Venus, like the earth, has an extensive atmosphere, so that the surface which we see is composed of clouds floating high in its upper and colder levels.

A second very interesting application of the thermopile (which promises to be one of the most important instruments of future investigation) comes from Nicholson and Pettit at Mount Wilson. With the 100-inch telescope, and a similar apparatus, they have measured the heat which we receive from various stars, and its transmission by a water-cell. For the whiter stars the percentage of transmission is very high, showing them to be hotter than the sun (as was found some years ago by Coblentz). For the redder stars less heat gets through the water-cell, but the total amount of heat is very much larger in proportion to the star's light. The extreme is reached in certain variable stars of long period, which send out more than a thousand times as much heat, in proportion to their light, as does a star like Vega. Put otherwise, they give out less than a thousandth as much light for the same amount of heat. Their "luminous efficiency" is very low. Now this is a familiar characteristic of bodies at a low temperature. It looks as though these stars were far cooler than the rest—indeed, the authors estimate the surface temperature at about 1500 degrees. This is quite new, and opens up an important field of work.

Though nothing was said about it at the meeting it may be noted here that according to newspaper reports of such conspicuous accuracy in detail that they are evidently authentic, Abbott at Mount Wilson has succeeded in the far more difficult task of measuring the heat energy sent us by the stars, after it has been dispersed into a spectrum by a prism. The information thus obtained regarding the distribution of energy in the different parts of the spectrum will make it possible to determine star temperatures with much increased certainty.

There were many more things told at the meeting which are worthy of retelling here; but the rest must go over till next month. Meanwhile, any reader who fears lest such application to science in torrid weather may have affected the health of American astronomers may be consoled by knowing that, at the suggestion of one of the most distinguished members, the Society adjourned on one occasion "to experiment upon the solubility of its members" in the grateful waters of the lake.



At 11 o'clock: Nov. 7.
At 10½ o'clock: Nov. 14.
At 10 o'clock: Nov. 22.
At 9 o'clock: Dec. 7.
At 8½ o'clock: Dec. 15.
At 8 o'clock: Dec. 23.
At 9½ o'clock: November 30.

NIGHT SKY: NOVEMBER AND DECEMBER

The Heavens

Turning to our map of the skies, we find the great square of Pegasus high in the southwest—almost overhead. From Pegasus a long line of stars runs northeastward through Andromeda and Perseus to Auriga, below which Gemini is beginning to rise. To the right, and due east, is Taurus, with Orion half risen. The southern sky, occupied by Eridanus, Cetus and Aquarius, is dull except for Fomalhaut in the southwest. Cygnus, Lyra and Aquila are grouped in the west. Cassiopeia is high in the north, the Pole-star, lower, and Draco and Ursa Major very low.

The Planets

Mercury is a morning star all the month. At its beginning he is well placed, rising at 5 A. M. and getting well up before the daylight overtakes him. As time goes on he draws in behind the sun and is lost to sight. On the 10th he is within a degree of Jupiter—a pretty conjunction.

Venus is an evening star when November begins, but is low in the west, even at sunset. She is at first almost stationary in the heavens, but soon moves westward to meet the sun, and passes through conjunction on the 25th, becoming a morning star, though not visible as such until after December has begun.

Mars is an evening star in Capricornus and sets about 10 P. M. in the middle of the month. He is steadily receding from us and growing fainter, but is still brighter than any star in this part of the sky.

Jupiter is a morning star, and is easily visible toward the end of the month, when he rises at 4:30 A. M. Saturn rises about an hour before him, and is also conspicuous before dawn.

Uranus is in Aquarius and comes to the meridian at 7:10 P. M. on the 15th. Neptune is on the boundary between Cancer and Leo, and souths at 5:45 A. M. on the same date.

The moon is full at 2 P. M. on the 4th, in her last quarter at 3 A. M. on the 12th, new at 7 P. M. on the 18th, and in her first quarter at 3 A. M. on the 26th.

Recently Patented Inventions

Brief Descriptions of Newly Invented Mechanical and Electrical Devices, Tools, Farm Implements, Etc.

Pertaining to Aeronautics

APPARATUS FOR AIRCRAFT.—F. E. SCHOLFIELD, R. F. D. No. 2, Waterford, Conn. The invention refers particularly to an electro-magnetic means for the application of a braking force to an airplane. One of the objects is to provide means for stopping or starting an airplane in a limited area such as the deck of a ship, or roof of a building. Another object is the provision of a device which may be employed as an anchor to prevent an airplane, dirigible or the like from blowing away from its moorings, or being shifted by the rolling or pitching of a vessel.

PARACHUTE. — C. L. NEWMAN, 2321 Grant St., Berkeley, Calif. The object of the invention is to provide a parachute that may be connected to an airplane and serve to retard the fall of the same in case of an accident. The parachute is so constructed that it can be permanently secured to the airplane. Provision is made that it can be put in action by the release of a lock, and will properly unfold to engage a sufficient amount of air to prevent any collapsing, even in case the plane is engaged in a nose dive or tail spin.

AIRPLANE.—E. WILDER, Box 83, Boulder, Colo. The general object of the invention is to provide an airplane adapted for the carrying of passengers and their baggage, the plane is constructed to provide all conveniences for the comfort of passengers as well as operators, the object being to make the plane as comfortable as a Pullman; four high-power engines are provided to eliminate possible engine trouble, the idea being to navigate the airplane at the lowest practical height, so that the elements of safety with high power may be obtained. (See Fig. 1.)

Pertaining to Apparel

GARMENT SUPPORTER.—H. V. CLAUSS, Room 530, 15 Park Row, New York, N. Y. This invention while adapted to be embodied in other garment supports is more particularly designed for embodiment in carters. The general object is to provide a spring connection for the band to serve the purpose of elastic webbing, with special consideration to the facility with which the band may be connected or disconnected from the spring.

UNDERGARMENT.—MARY MOORE, Wilber, Neb. The invention relates particularly to undergarments for children, an object being to provide a construction of combined shirt and abdomen band provided with a diaper supporting means on the garment. The garment can be easily and quickly placed in position on the child, or removed therefrom, and will efficiently perform the functions for which it is intended.

GARMENT CONSTRUCTION.—J. SEEWALD, 961 E. 9th St., Brooklyn, N. Y. The invention more particularly refers to the waistband and lining structure of men's trousers, and specifically to the finishing off and attachment of the rear ends of the lining strips to the rear seam of ready-made trousers. One of the principal objects is to provide means for securing the rear ends of the waistband lining strips in a neater and more effective manner which give to the garment a hand-tailored appearance.

REFOOTING STOCKINGS. — H. A. BERENDSEN, Berendsen Silk Mills, Bangor, Pa. The invention relates to hosiery of the more expensive type and made of woven silk cloth or embroidery material. An object is to permit such stockings to be refooted a number of times, rendering the stocking practically as good as new, at a comparatively low cost, thus saving considerable expense in the cost of hosiery.

Chemical Processes

PROCESS FOR THE PREPARATION OF AROMATIC NITRAMINES. — L. HAAS, 12 Rue des Wallows, Paris, France. The object of the invention is to dispense with heating in an autoclave, and to enable the reaction in question to be effected at regularly low temperatures. To this end, in accordance with the invention, the chloronitro-derivatives in question are heated with ammonium acetate, the operation being performed in an apparatus provided with a reflux condenser and an agitator.

Electrical Devices

ELECTRICAL CONTROL RAILWAY GATE.—J. H. TAYLOR and E. F. LA FRAY, 1249 Hinkley St., Detroit, Mich. The invention relates to a gate construction for railway crossings, the gate's action being electrically controlled by the passing of a train in either direction. The gate itself is strong and held in effective position when closed. One of the main features is to minimize the necessary excavation adjacent to railroad tracks, and to do away with stop posts for holding the gate in position. (See Fig. 2.)

ELECTRICAL FURNACE.—R. A. DRISCOLL, P. O. Box 454, Antioch, Calif. An object of the invention is to provide an electric furnace in which ore, slagging materials, and fuel is charged into the furnace by means of a rotary tube through which the waste gases from the furnace pass and where a partial reduction of the ore takes place. Another object is to provide a furnace which is automatically charged, and in which a low grade of fuel may be utilized.

ELECTRIC LAMP.—E. G. MASCARENHAS, Avenda, Rio Branco 2392, Juiz de Fora, Estade de Minas, Brazil. The invention relates to an electric lamp of the glow-lamp type. An object is to provide an incandescent lamp in which a number of filaments are provided and associated with a switch mechanism at the base of the lamp in such manner that one or more filaments may be connected up with a source of current when the lamp is in use.

AUTOMATIC PRESSURE-OPERATED SWITCH. — W. L. HAMILTON, Bangor, Mich. The invention relates to electric motors used for operating pumps, and its object is to provide an automobile pressure-operated switch arranged to automatically stop the motor as soon as the desired pressure is reached and to restart the motor immediately after the pressure decreases below the predetermined to be maintained by the switch.

ELECTRIC HEATING UNIT.—R. G. KLOEFFLER, c/o Kansas State Agricultural College, Manhattan, Kans. An object of the invention is to provide an electric heating unit so constructed as to permit the resistance wire to be readily replaced when burned out. A further object is to provide a unit which can be readily assembled without the necessity of using a multiplicity of screws, bolts, or similar retaining devices, the major portion being stamped from sheet metal, and can therefore be cheaply manufactured.

BATTERY GRIP.—C. E. JOHNSON, 323 Andrich St., Fort Scott, Kan. The invention relates to grips for connecting lead wires to the battery terminals. The grip comprises S-shaped jaw members pivoted near the upper ends, a spring connected to the jaw members to normally retain the ends in engagement with one another, screw attaching means on one of the jaw members, and a guide for controlling the movement of the jaws.

TESTER.—W. P. COOK, 1714 So. Flower St., Los Angeles, Cal. The aim of this invention is to provide a device which will serve to indicate the proper operation of the circuit, together with the quality of spark produced by means of the plug associated with the circuit. The invention is primarily intended for use in connection with spark plugs of internal combustion engines, although not limited to this particular adaptation.

FUSE.—J. A. NELSON, 542 Huger St., Charleston, S. C. An important object is to provide a fuse of the plug type which when ruptured by an excessive flow of current may be easily detached without resorting to the use of testing apparatus. A further object is to so locate the blowing portion that when the fuse has blown it will be clearly visible through the mica covering of the fuse.

STOP MOTION.—E. F. and J. F. CONNELL, c/o McCaleum Hosiery Co., Northampton, Mass. The invention relates more particularly to stop motions of the kind in which one or more electric circuits normally closed are opened as a means of controlling the stoppage of the machine. The device relates to stop motions suitable for use upon looms, knitting machines and other devices for manufacturing fabrics and in which the stop motion is under the control of a thread normally taut.

MAKE-AND-BREAK IGNITION DEVICE.—M. MURRAY, Williams Wharf, Va. The invention relates more particularly to the make-and-break devices primarily used in connection with marine engines, the object being a provision whereby the spark points may be adjusted. A further object is the provision of means permitting of screw adjustment of the oscillating rocker rod, in order to avoid the necessity of refiling of the rocker rod at each adjusting operation.

SWITCH SUPPORTING ATTACHMENT FOR ELECTRIC FIXTURES.—F. L. BUTLER, 740 E. 36th St., Chicago, Ill. The invention relates to an electric fixture having a depending stem, adapted to be attached to a ceiling. An object being to provide a fixture provided with means adapted for connection with a lighting fixture element and with a switch for controlling the operation of the incandescent lamps, the number of essential parts being reduced to a minimum ease of assembly is attained.

ELECTRIC FIXTURE.—F. L. BUTLER, 740 E. 36th St., Chicago, Ill. An object of the invention is to provide a fixture and an insulating member having a central bore adapted to receive an ordinary tubular member formed with a so-called "running thread" and having means for limiting the movement of the tubular member within the insulating nipple and for maintaining the same in adjusted position therein.

Of Interest to Farmers

RESTRAINING APPARATUS. — G. CORTEZ, address E. M. McLaughlin, 2643 Mommouth Ave., Los Angeles, Calif. The invention relates to a restraining apparatus and operating table especially adapted for use in connection with pigs. An object is to provide a restraining or holding apparatus which may be employed for safely holding a pig while being operated upon. The device may be readily adjusted for use in connection with pigs of various sizes, and may be operated entirely by one man, the operator having free access to the animal. (See Fig. 3.)

HARROW.—F. G. BIGGERSTAFF, 2627 Tracey Ave., Kansas City, Mo. The object of this invention is to provide a harrow which may be rendered operable or inoperable at will and while in motion, which may be raised above the ground, by means of a cam-lever, whereby to be cleared of accumulated debris, and which is of simple and durable construction, reliable in operation and easy and inexpensive to manufacture. The harrow may be drawn by tractor or other suitable means. (See Fig. 4.)

HAY LOADER.—P. L. FORBES, Stauffer, Ore. This invention relates to a device which efficiently loads a hay wagon in a manner to utilize the maximum capacity of the wagon, which dispenses with the necessity of a number of operators, does not require an independent power plant, and which is automatic in certain phases of its operation, requiring the simplest manipulation, so that it is necessary to exercise only a minimum degree of attention to control the loader.

FARM TRACTOR.—L. W. TABER, c/o Mrs. H. Taber, 1614 Wilcox St., Indianapolis, Ind. The purpose of the invention is to provide a tractor having means at the front of the vehicle for steering the same which is operable by steering rods disposed at the front and rear of the vehicle, such rods being capable of movement to an inoperative position so that one or the other can actuate the steering mechanism inde-

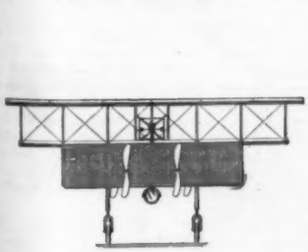


Fig. 1: Pullman airplane designed and patented by E. Wilder

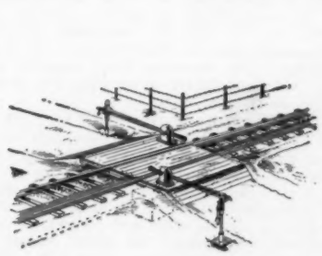


Fig. 2: The Taylor and De Fray electrically-controlled gate for railroad crossings

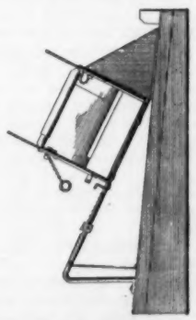


Fig. 3: G. Cortez's apparatus to facilitate operations upon pigs

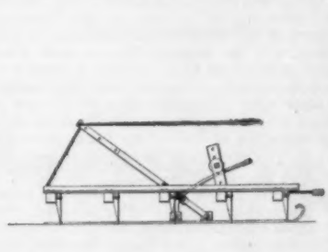


Fig. 4: Automatic hay-loader, the invention of P. L. Forbes

Fig. 5: J. N. Meyers' device for aiding in the teaching of freehand drawing

Fig. 6: Guard for collar and cuff buttons invented by F. F. Schultz

Fig. 7: Sieve with removable bottom developed by W. J. Johnson

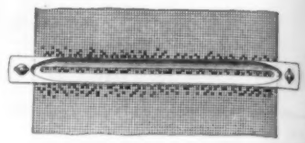


Fig. 8: Work-holder for the crochetist, patented by A. B. Henderson

pendently of the other. The driving mechanism is so constructed as to permit the hauling of cultivators of various sizes.

BEET TOPPER.—S. C. WARNER, c/o G. A. Bell, Grand Rapids, Ohio. This invention is intended for use in connection with beet lifters, to top the beets before they are dug by the lifting mechanism. One of the objects is to construct the device in such a manner that the topping knife will follow the surface contour of the ground, so that the knife may be set to insure a uniform topping of the beets.

TRACTOR HITCH.—O. B. SKONNORD, Box 515, Valley City, N. D. An object of the invention is to provide a tractor hitch which will be actuated automatically through the medium of a spring member to release the load when an undue stress is placed upon the hitch and which moreover will be automatically set to again engage the load without any manual manipulation of any of the parts.

FOUR-HORSE EQUALIZER.—J. ROBSON, R. R. 3, Anita, Iowa. An object of the invention is to provide a draft-equalizing device or evener for four draft animals, whereby sufficient space is at all times afforded for the movement of each animal without interfering with the movements of the remaining animals. A further object is to provide a device that is adapted for application to an agricultural implement, such as a gang or sulky plow, the stress on the draft animals being reduced to a minimum.

SINGLETREE.—J. M. MOORE, R. F. D. No. 2, Box 98, Laurel, Miss. An object of the invention is to provide a hook for use in connection with single trees, wherein a guard is provided for the bill of the hook, to prevent said bill from catching growing plants and the like, and preventing injury of the horse's hoof in case the hook should be stepped upon, and for preventing disengagement of the draft tugs.

Of General Interest

HOSPITAL CHART. — FRANCE M. ECKES, c/o Druggist's Supply Co., 145 Lafayette St., New York, N. Y. An object of the invention is to provide a chart of neat and attractive appearance whereon a graphic record of a patient's pulse, temperature and respiration may be kept and a chart whereon a written record of the same data may be displayed, serving as a check one upon the other, so that mistakes in recording are reduced to a minimum.

CANDLE.—J. A. P. ERICKSON, Box 404, Northland, Minn. An object of the invention is to provide a candle which will sparkle and produce a pleasing optical effect, and which is adapted for use as an ornament for Christmas trees, birthday cakes, etc., which will be simple in construction, practical in use, and comparatively inexpensive to manufacture.

LIFEBOAT.—W. STEWART, 18 Taylor St., Newark, N. J. One of the principal objects of the invention is to produce a boat which may be properly nested with other boats of the same kind, whereby a number of such boats will occupy a minimum amount of deck space, and whereby a single pair of davits may be conveniently utilized to effect the launching of each of the boats singly.

COPY APPARATUS.—L. F. MORSE, 600 E. 21st St., Brooklyn, N. Y. An object of the invention is to provide a copying device of the transparent reflecting surface type, in which the various surfaces may be manipulated to obtain a maximum distribution of the light rays so that the image will be reflected to the best advantage, and the operator will be capable of quickly tracing the picture to be copied.

WINDOW CONSTRUCTION.—J. F. and F. J. STECKENREITER, 251 E. 26th St., Brooklyn, N. Y. The invention has for its object the provision of a window construction in which the greatest possible lighting area is provided for a given strength of window. Another is the provision of means whereby all parts of the sash are open for inspection and painting, and in which the structure is to a maximum degree weather and draftproof, and the tendency of the sashes to rattle is reduced to a minimum.

APPARATUS FOR THE MANUFACTURE AND DISPLAY OF BEVERAGES.—J. H. MALLON, 213 Leande Ave., Atlantic City, N. J. Among the objects of the invention is to provide a highly attractive display and advertising apparatus in the nature of a booth which also includes means for extracting fruit juices from the fruit, such as oranges, for its dispensation as a liquid beverage. The device is comparatively simple in construction and operation.

SIFTER.—E. G. DALTON, 766 Atwell Ave., Providence, R. I. The invention relates more particularly to an ash sifter having a vibratable sieve structure adapted to receive a removable pan and being enclosed in a dust-proof housing, the pan sloping toward the back end of the box structure.

CRADLE.—HERTHA J. NISLE, c/o MRS. L. B. Calkins, 4871 Winthrop Ave., Chicago, Ill. An object of the invention is to provide a child's bed of the type of construction commonly known as a cradle, in which a body or receptacle in which a child may be placed is supported for oscillation, and means are provided for oscillating the receptacle, the oscillatory movement being varied at will.

FLY SWATTER.—J. C. FIELD, 1515 W. Monroe St., Chicago, Ill. The invention relates to fly swatters especially adapted for use on screen doors. An object is to provide a swatter which is automatically actuated by the movement of the door, and is provided with a detachable receiver for collecting the flies as they are killed. The device may be conveniently applied to the door at any time and does not mar the appearance of the door.

MEANS FOR SECURING THE SECTIONS OF A MAST OR POLE TOGETHER.—F. JAECKLE and P. MEHLHORH, Freiburg, Germany. The object of the invention is to render it possible to exchange the part of the pole destroyed by the process of decomposition for a new and sound one and to rigidly connect the latter with the part of the pole which has remained sound, this being accomplished by an arrangement of plates on the sections to overlap their abutting ends.

KEY HOLDER.—C. L. OBERLAND, Highway Hotel, Bucyrus, Ohio. The invention relates to a holder particularly adapted for hotel room keys. The object is to provide a holder to which the room key may be attached for identifying the room to which the key belongs, and to serve as a reminder to the guest that the key is in his possession, and thus avoid the possibility of his carrying away the key when leaving the hotel.

MOLD FOR CASTING STEREOTYPE PLATES.—C. WINKLER, Berne, Switzerland. The invention relates to a mold having a water mantle for cooling the back of the plate. The water mantle is divided into two chambers, and the water is to be laid first into the inner or lower end chamber to cool the wall of the mold, and then into the outer or upper chamber on the other side of the wall, from which it can escape by overflowing.

SMOKING APPLIANCE.—J. B. GARCIA, 658 Hampshire St., San Francisco, Calif. The invention relates more particularly to an ash retaining device which is peculiarly adaptable as a protective housing made to receive and confine the burning end of a cigar, cigarette, or the like. The device is composed of a perforated barrel-like casing with a gauge lining and hinged cover, and empaling points to be embedded in the sides of the cigar for keeping it in place.

TRAP.—H. PIERINI, c/o R. B. McMahone, Opera House, Greenville, Mississippi. The object of the invention is to provide a trap especially adapted for catching mice, rats and the like. A frame is provided which may be connected to a table or shelf, the frame supporting a pivoted plane so arranged that it will be tilted by a slight excess of weight at one end, whereby the mouse in its efforts to reach the bait will be dumped into a container of water to result in drowning.

REFRIGERATING APPARATUS.—H. C. BUCHERE, 238 Rutledge Ave., Charleston, S. C. The invention relates more particularly to refrigerator boxes employing mechanical refrigerating apparatus, including a condenser, said box having a vertically extending air conduit whose lower end opens into the box and whose upper end opens through the top of the box, and a condenser arranged in the upper portion immediately adjacent the top.

DAM AND METHOD OF CONSTRUCTING SAME.—H. W. HIXON, 115 E. 82nd St., New York, N. Y. The invention relates to a method of constructing a dam including a body consisting of stones of various sizes and a net for positioning and anchoring the dam in the bed of a stream, the net being bellied down stream to provide a pocket for the reception of the stones upon the lower edge of which the stones will rest to anchor the same to the bottom of the stream, and a suspension means for anchoring the upper edge of the net.

EDUCATIONAL DEVICE.—J. N. MEYERS, 2432 W. York St., Philadelphia, Pa. The invention relates to an educational appliance which may be used in all grades in schools, as well as in the home. The object is to provide a device adapted to aid in teaching free-hand drawing. It is a further object to provide a sheet upon one side of which is a section of a reproduction to be copied, to be committed to memory and to be drawn on the blank space adjacent the filled in section. (See Fig. 5.)

CLAMP AND BRACE FOR STAGE WINGS.—G. J. HANLON, 147 East Ave., Long Island City, N. Y. An object of the invention is to provide a combination clamp and brace for stage wings which is capable of folding when not in use whereby the same can be stored in a minimum amount of space. A further object is to provide a brace which greatly facilitates the erection of wings without resorting to the use of nails. The device is thoroughly reliable, and inexpensive to manufacture.

BABY WALKER.—R. NOEL, SR., 206 Dixon Ave., Du Bois, Pa. The invention more particularly relates to baby walkers in which provision is made for permitting the baby to travel back and forth longitudinally of the structure on an elevated platform to which legs are hingedly connected, the arrangement being for the purpose of readily setting up the structure when required for use, or conveniently assembling the same when in knocked down form.

PROTECTOR FOR COLLAR AND CUFF BUTTONS.—F. F. SCHULTZ, 647 Fox St., Bronx, N. Y. The object of the invention is to provide a simple device made in conjunction with or attached to a collar or cuff button to fasten the same effectively in position on the shirt and prevent its dislodgment. In general the device comprises a metal finger, the end of which is adapted to be inserted in a slit in the cuff or collar and turned to grip the fabric between itself and the base of the button. (See Fig. 6.)

BUILDING WALL. — H. W. HOWELL, 201 Lewisohn Block, Butte, Mont. The invention relates to concrete wall structures, the purpose being to provide a building wall comprised of standard units of various sizes which are formed and can be associated with each other so as to provide walls of any desired thickness while employing substantially the same amount of labor and material. The invention provides means for securing the units against movement.

PIN.—G. G. SPECK, 30 East 8th St. N., Portland, Ore. An important object of the invention is to provide a pin which may be held against displacement or accidental withdrawal from the material in which it is inserted. A further object is to provide means whereby the pin may be readily and securely grasped when it is desired to remove the same and break the locking engagement.

SIEVE.—W. J. JOHNSON, 401½ N. Vine St., Creston, Iowa. An object of the invention is to provide a sieve with a removable bottom so that a number of bottom-carrying screens of various size mesh can be used with the same body or rim. A further object is to provide means for supporting the screen within the sieve body, which will be simple, durable and comparatively inexpensive to manufacture. (See Fig. 7.)

DECIMAL-POINT DEVICE FOR CHART READERS.—G. O. GRAY, Box 234, Butte, Mont. The invention relates to moving decimal-point devices for chart readers, and has for its object to provide mechanism in connection with chart-exhibiting devices for facilitating the reading of the same. The device can be used on a variety of charts, such as pay-rolls, interest, bushels, assessments, etc.

COMBINATION VANITY CASE.—A. E. ROPE, Hotel St. George, Brooklyn, N. Y. An object of this invention is to provide a device which comprises a series of separably connected compartments which permit of an interchange of compartments and the omission of certain compartments, whereby the case may be reduced to suit the requirements of the user, and may contain all ordinary articles for the ladies' toilet.

SKYLIGHT VENTILATOR.—P. BOLOGH, 200 5th Ave., New York, N. Y. The ventilation comprises a pivoted frame and window, a portion of the window being disposed below the pivot point and adapted to swing outwardly when the window is moved to open position, said window having a normal open position, and means for holding the window in closed position, the mass of the window being so distributed that when released it automatically opens.

WORK HOLDER.—A. B. HENDERSON, P. O. Box 725, Hurley, N. M. The invention aims to provide a guide and holder particularly adapted for use in connection with crocheting work, the primary object is to so construct the guide that an amateur will be capable of properly aligning all parts of the design, the device retaining the goods in such manner that the parts being worked upon will at all times be visible. (See Fig. 8.)

HANDLE FOR DISHES. — R. HUBACHEK, Vincent Hall, Rutgers College, New Brunswick, N. J. The invention relates to holders for receptacles, such as cups, glasses, cooking utensils and similar articles. An object is to provide a readily applicable handle whereby articles which are broken can still be used, and whereby those not ordinarily supplied with handles can be so provided in order that they may be handled while hot.

BLOCK MOLD. — E. B. HOWELL, 201 Lewisohn Block, Butte, Mont. The purpose of the invention is to provide a mold which forms, without recourse to substitutes or any change of parts, building blocks of any desired length within the range of the mold, so that when making blocks necessary to the formation of a building wall, one mold may be employed throughout. It is also a pur-

pose to use a plurality of molds which co-act one with another to simultaneously form a plurality of blocks.

DIVING SUIT.—E. J. VALEUR, Barahona, Dominican Republic, West Indies. The invention relates to a diving bag of waterproof material to be worn as a suit, and of a character to be used, for example, in shallow water, tanks, dams, etc.; or for repairing or inspecting ship's hulls, wharves, bridges and the like. The general object is to permit freedom of movement on the part of the user, as well as to provide a suit with buoyant means to relieve the wearer of the weight of the suit. (See Fig. 9.)

TOOTHBRUSH.—W. S. FIELD, 1161 Broadway, New York, N. Y. This invention more particularly relates to a toothbrush so formed as to simultaneously brush both the inside and outside of a row of teeth. The toothbrush includes the usual form of handle with a short double row of opposed bristles which are set at an angle to go over the teeth and work on both sides at the same time.

SUPPORT.—E. D. ANGELL, c/o Thomas E. Wilson Co., 25 W. 45th St., New York, N. Y. An object of the invention is to provide a supporting base for an upright rod or pole which may be quickly and easily attached to or detached from an ordinary table top. A further object is to provide a supporting base for a game apparatus which will be strong and durable in use, will hold the post firmly yet will not scar the table top.

CURLING IRON.—A. SCHARER, 2580 Broadway, New York, N. Y. The principal object of the invention is to provide a curling iron operating on the principle of the waves to produce a Marcel wave in a short length of time. Another object is to provide a pair of parallel offset tongues with spacing blocks and heating coils located within the tongues for producing the peculiar conformation of the wave.

BUILDING CONSTRUCTION.—C. J. ASCHAUER, Decatur, Ill. The invention particularly relates to a wall in which a single layer of facing bricks are employed with columns formed of pre-cast hollow units and run-in-place concrete, the latter forming beams integral with the concrete of the columns. The general object is to provide a construction relieving the facing brick of all strains but the lateral stresses and to reinforce the facing by elements anchored in the run-in-place columns.

METHOD OF COOLING LIQUIDS AND CHARGING THE SAME WITH GAS BY THE USE OF SNOW-LIKE CARBONIC ANHYDRIDE.—V. CREMIEU, 54 Faubourg Saint Honore, Paris, France. This invention relates to a method for simultaneously cooling and charging any suitable liquid with gas, and more particularly a drink. An object is to provide a perforated bell-shaped member with a handle for receiving the proper amount of snow-like carbonic anhydride, and permitting the maintenance of the same in said liquid for the proper amount of time.

FISH LURE.—C. M. RODGERS and A. W. WENGER, c/o Wenger Mfg. Co., Warsaw, Ind. An object of the invention is to provide an artificial bait or lure having detachable barbed hook for use in casting or trolling for game fish, the lure being adjustable to move at various distances beneath the surface of the water with a wiggling motion when drawn along and to thereby attract the attention of the fish.

DIVING BELL.—M. A. WHITE, 49 Ellicott St., Beverly, Mass. The primary object of the invention is to provide a hydraulic device which may be lowered beneath the surface of the water into contact with the bed of the water to permit of mechanical operations thereon. A further object is to provide means for expelling water from within the device after the same has been placed in operative position, and to provide air pressure regulated at the will of the operator.

COLLAPSIBLE MOLD FOR CONCRETE STRUCTURES.—H. J. KESTLER, 541 Manor Road, West New Brighton, S. I., N. Y. This invention more particularly relates to a mold for forming a structure with double walls having a space or cavity extending with substantial continuity to run with the wall or around the several sides of the structure. An important feature of this knock-down mold is that it embodies collapsible core units, said units being characterized by their clamping relation to positioned planks.

COMBINATION SCRAPER, CHARGER AND TAMPER.—T. J. AVERY, Albia, Iowa. Among the objects is to provide a device having a charging barrel of uniform diameter and a coupling member having a diameter not greater than that of the barrel for connecting the latter with an operating rod, whereby an explosive charge can be effectively tamped in a bore in the place of a mine wall without any part of the charge being withdrawn when the charging barrel is retracted.

TRACING DEVICE.—J. N. MEYERS, 2432 N. York St., Philadelphia, Pa. The primary object of the invention is to provide a tracing device which is simple in construction, in which the writing surface may be maintained immovable with respect to the base, thus insuring at all times a proper positioning of the picture relative to partially clamped tracing upon the transparent writing surface. The device is strong and capable of withstanding more than ordinary abuse.

WINDOW-OPERATING DEVICE.—C. I. GOLDBLATT, 700 Willoughby St., Brooklyn, N. Y. An object of the invention is to provide a simple and practical apparatus which will entirely obviate the necessity of manually raising or lowering window sashes. A further object is to provide a novel form of hydraulic mechanism, the various inlet and outlet pipes being concealed within the wall, so that only the push buttons for operating the valves are visible when the apparatus is installed.

NURSING BOTTLE AND NIPPLE PROTECTOR.—W. WEISSHEIER, 24 Ingram St., Brooklyn, N. Y. The invention relates to nursing-bottle attachments, and has for its object to provide a construction wherein the bottle is properly supported in position and the nipple thereof protected when not in use. Another object is to provide a bottle with a projecting ring adapted to coact with ribbons or other means for tying the bottle to a carriage so that the nipple will be within reach of child using the bottle.

HYDROCHEMICAL CLEANER.—B. MCCARTHY, 410 Franklin St., Tampa, Fla. The invention is especially adapted for use in cleaning jewelry and other small articles. It aims to provide a means whereby jewelry and other small and precious articles may be safely subjected to a uniform flow of the cleaning liquid to thoroughly remove all dirt, without needing the operator to submerge his hands in the liquid.

HAIR CURLER AND WAVER.—A. V. P. MARTIN, 944 Gravesend Ave., Brooklyn, N. Y. The object of this invention is to provide a hair curler or waver which may be used on either long or bobbed hair. The device will produce either round waves, side puffs, or long curls for children. An object is to permit the user to readily open the device to apply it to the hair, to close it after positioning, and to release the hair after the operation is complete, without the slightest danger of entangling or breaking the hair. The curlers may be comfortably worn all night without injuring the finest hair.

CIGARETTE HOLDER.—T. DUNCAN, 511 E. Front St., South Oil City, Pa. The invention has for its object to provide a device which may be held upon the finger like a finger ring and which is provided with means for grasping cigarettes between blades pressed resiliently toward each other, the grasping portions of the blades being placed sufficiently far above the finger engaging means to hold the cigarette far enough from the finger to prevent burning.

BUNG FOR TANK FILLING AND DISCHARGE FITTINGS.—J. DARLING and W. W. CURRY, Chicora, Pa. The invention relates generally to the filling and discharge of tanks, and more particularly to metallic barrels or containers for gasoline and other fluids in connection with which the formation of gas within the container renders such operation, particularly the discharge operation, difficult in so far as guarding against waste is concerned.

FORT DISAPPEARING GUN.—C. OTTOLINI, 2001 Union St., San Francisco, Cal. An object of the invention is to provide a stationary disappearing toy gun that is simple in construction, substantial, that will throw a projectile with considerable force, and allows aim to be taken with a high degree of accuracy. Means are provided for thrusting the barrel upward and forward, and a spring for impelling the projectile.

METHOD OF EXTRACTING FERTILIZER ELEMENTS FROM MANURE.—C. E. GARDAN, Wilson Creek, Wash. The general object of the invention is to provide an apparatus whereby all fertilizer elements may be separated from the fiber in manure or refuse and thus produce a concentrated fertilizer to enable the easy handling of the same. A further object is that the apparatus be adapted to permit the introduction of any necessary fertilizing elements not present in the manure being operated upon.

CIGAR AND CIGARETTE ASH RETAINER.—C. H. KATTENBERG, 562 17th Ave., San Francisco, Cal. The primary object is to provide a simple and practical device in which cigars, cigarettes, and even loose tobacco, may be confined for smoking purposes, and one which will retain the burnt ashes and thus overcome the inconvenience caused when the ashes are permitted to be scattered around a room, or blown in the face of a person while riding in a vehicle.

COMBINATION FACE BRUSH.—A. E. ROPE, St. George Hotel, Brooklyn, N. Y. An object of the invention is to provide a device which combines in one holder all the apparatus necessary for the care of the face before and after shaving. The device comprises a shaving brush, a massage device, a shaving stick, a container for talcum powder, a container for massage cream, covers for said receptacles, and all the parts embodied in a single member which is separable and will be sanitary for use, and occupy but small space.

HANDBAG CATCH.—B. P. CULLEN and M. J. WOCHNA, 38 Wayne St., Jersey City, N. J. The invention relates to catches for securing the frame jaws of handbags, pocketbooks, and the like. One of the principal objects is to provide a catch in which the means for releasing the same is a removable element attached to the handle of the bag. A further object is to provide a plurality of keyhole openings, only one of which registers with the catch, in order to baffle attempts of unauthorized persons in opening the bag.

BED ATTACHMENT.—F. CORTESE, R. 19, New Brunswick, N. J. The invention aims to provide a device more particularly adapted for use in connection with supporting bed clothes, spaced from the body of the person occupying the bed. The attachment includes clamping members and socket members, certain of the socket members being pivotally attached to the clamping members, shafts adapted to have their ends extending into the socket members, and interconnecting rods pivotally associated with the shafts.

FLEXIBLE METALLIC STRUCTURE.—H. MAXENCHS, 234 E. 50th St., New York, N. Y. The invention refers more particularly to structures for jewelry, such as bracelets, necklaces, and the like. More specifically a flexible metallic structure which is composed of a plurality of link elements having a concealed means of connection, the assembly being such as to permit of limited flexibility in one direction and precluding bending in the opposite direction.

DISPENSING DEVICE.—E. and G. KENT, c/o C. E. Phenicie, 111 E. 34th St., Tacoma, Wash. The aim of the invention is to provide a device adapted for use in forming an ice cream brick. A further object is to construct a device which will be extremely simple, may be readily operated, and is capable of association with various sizes of freezers, and permits absolute control of the thickness of the layers, forming a complete brick.

BOLT FOR SPRING RINGS AND PROCESS OF MANUFACTURING THE SAME.—L. LEMAITRE, 20 Boulevard des Filles-du-Calvaire, Paris, France. The invention has for its object a method of making bolts of spring rings employed more especially in jewelry. The process consists, essentially, in forming the bolt of metal wire of semi-cylindrical cross-section, bent back on itself at its ends in such manner as to give to the whole a cylindrical form, the button being also produced by folding back a convenient portion of the metal wire and subjecting it to the action of a suitable machine.

EXTENSIBLE LADDER FOR FIRE ESCAPES.—R. GLASSER, 294 Church St., San Francisco, Calif. The particular object of the invention is to provide a drop ladder to reach from the first balcony, where stationary fire escape ladders usually finish, to the ground. The drop ladder may be permanently fixed at a convenient height above the floor of the balcony, and may be quickly and easily lowered to the ground by means of bevel or worm gears and a hand wheel. (See Fig. 10.)

PAPER HOLDER.—J. A. F. GRIMBEL DU BOIS, 243 O. Z. Voorburgwal, Amsterdam, Holland. The invention relates to a paper holder especially adapted to retain sheets of paper in flat position. It may be used as a paper holder for letters, checks, bills, or sheets of paper of any kind, for convenient observation, or may be used in banks for holding checks or paper money, which may be placed in the device single handed by a downward pressure of the table, when the sheet resting on the gripper drops by gravity, the movement leaving the operator with one hand free. (See Fig. 11.)

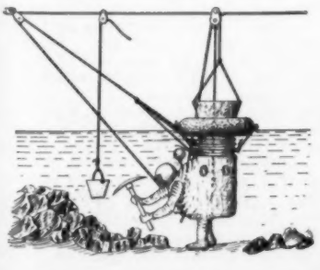


Fig. 9: Diving suit of novel design invented by E. J. Valeur

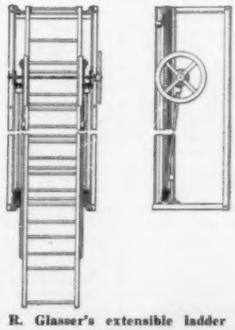


Fig. 10: R. Glasser's extensible ladder for fire escapes

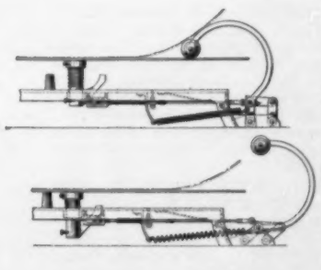


Fig. 11: Paper-holder of wide applicability invented by J. A. F. Grimbel Du Bois

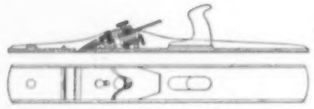


Fig. 12: Simple, single-bladed plane designed to be capable of very fine adjustment; the invention of H. Anderson

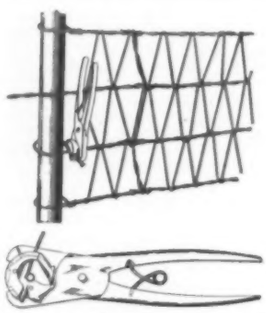


Fig. 13: J. C. Mahan's wire-fence-erecting wrench

Fig. 14: Adjustable-head soldering iron patented by H. F. Hammond

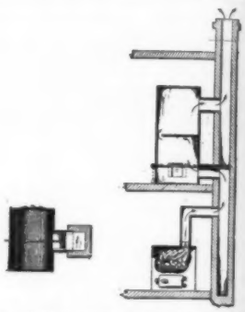


Fig. 15: Heat-conserving device for use with ordinary stoves, invented by D. Griffith

Hardware and Tools

SINGLE-BLADE PLANE.—H. ANDERSON, 2850 School St., Oakland, Calif. One of the most important objects of the invention is to provide a plane that is capable of very fine adjustment, yet is comparatively simple in construction, the plane is so constructed that it holds the blade in such manner that it can be used as a block plane as well as a smoothing plane. (See Fig. 12.)

KNIFE.—E. KRAFFT, 501 No. Eutaw St., Baltimore, Md. The object of the invention is to provide a knife particularly arranged for cutting the rind from bacon or a like purpose, having a guide or gauge means associated therewith whereby the rind from the bacon may be expeditiously removed. The knife may also be utilized for slicing the bacon into strips after the rind has been removed.

COMBINATION KEYLESS NIGHT LATCH.—J. SOMORA, 362 N. Avers Ave., Chicago, Ill. Among the objects is to provide a combination locking device that is adapted to be applied to a door and operatively connected with the spindle of a door lock of ordinary construction, whereby the lock cannot be operated by persons not having the requisite knowledge as to the combination. The device being "keyless" is more difficult to operate by unauthorized persons than an ordinary night latch.

TOOL.—J. M. BRANDT, Iowa Marine Engine and Launch Works, Bellevue, Iowa. The invention has for its object to provide a device comprising a pair of jaws having screws threaded through the intermediate portions, the jaw being forked and especially adapted for pressing taper battery terminals from battery posts, without throwing strain upon the cover that might be liable to injure the same.

TOOL OPERATING MACHINE.—A. SALATA, 207 E. 15th St., New York, N. Y. The invention has particular reference to a machine for use in connection with the operation of saws, files, and similar devices. An object is to provide means whereby the tool which is being actuated, is held in such a position as to permit of the use of the tool in narrow and cramped quarters and unusual positions.

AWNING BOX.—D. FROEHLICH, 870 De Kalb Ave., Brooklyn, N. Y. Among the objects of the invention is to provide an awning box in which the parts are normally locked to prevent tampering with the same, the locking device being capable of ready disengagement to permit of the actuation of the mechanism, and to insure against any accidental relocking of the mechanism. The device is simple in construction and may be manufactured at a low figure.

CHAIN PLIERS.—R. I. SHIBIYA, 622 N. 38th St., Omaha, Neb. The general object of the invention is to provide a tool for opening and closing chain links, which is complete in itself for the necessary operations on a chain without employing other tools and expedients such as is usually necessary with chain pliers as ordinarily made. The device is well adapted for use in placing or removing tire chains.

MANDREL FOR ABRASIVE AND POLISHING TOOLS.—H. F. STEMPEL, JR., c/o Herminghausen & Herminghausen, Attorneys, Fort Madison, Iowa. A purpose of the invention is to provide a mandrel which securely holds grinding and polishing wheels and discs against slippage, and in such manner as to prevent concentration of stress around the edge of the mandrel, thus preventing the wheels from cutting out or breaking at the center and thereby materially prolonging the life of the wheels. A further object is to provide means for yieldingly supporting the wheels.

CABLE CUTTING DEVICE.—T. WEBB, c/o Woods Hotel, Vancouver, B. C., Canada. The invention relates to devices for cutting cables or the like, the purpose is the provision of a device of extremely simple, durable and efficient construction, and one which is operable to effect a secure gripping of the cable prior to and during the cutting operation so as to render the actual cutting extremely easy and accurate, the device having blades which co-act to effect a shearing cut thus lessening the strain and preventing a rapid dulling of the cutting edges.

PLIERS.—F. T. FOEHL, 36 Devoe St., Brooklyn, N. Y. The invention aims to provide pliers intended for use by opticians and oculists. The object is to provide pliers by means of which an optician or oculist may readily associate the plate of an eyeglass with the rim, without any danger of the latter becoming crushed by careless handling of the pliers. The device is capable of use in connection with eye-glass rims of widely varying sizes.

COMBINATION TOOL.—A. J. HART, c/o F. N. Hunt, Cromwell Handy Tool Co., Cromwell, Ind. An object of the invention is to provide a combination tool which is capable of functioning as a wrench, pliers, a hammer, a nail-puller, a vise, a wire cutter, a clamp, or a nutcracker. Another object is to provide a tool which is simple and durable, and designed to perform the work of a plurality of tools without the necessity of removing a single element of the combination.

LOCK.—J. SLAIBELLE, c/o Addie J. Sprague, Rock Maple Farm, Ludlow, Vt. The invention has for its principal object the provision of a simple and inexpensive lock, particularly designed for doors. Another object is to provide a lock which comprises in connection with the usual knob-actuated latch, means capable of securing the same in a position to obstruct the opening of the door, and a bolt and key having a gravity-actuated finger for engagement therewith to operate the same.

WRENCH.—A. C. KLOPPER, 317 4th Ave., Bradley Beach, N. J. An object of this invention is the provision of a gear-driven socket wrench which can be conveniently used for removing or replacing nuts which are awkward to reach, and which is in the form of a crank arm, so that the gears may be locked to allow the crank arm to be used as a lever wherever nuts are in more accessible places or wherever greater leverage is desired to start the nut.

GRAPPLE.—C. H. BROWN, c/o Brown Welding and Machine Co., Breckenridge, Texas. The invention aims to provide a tool having simple means for gripping an under-reamer lug or the like to permit of the removal of the under-reamer lug should the same become detached while drilling a hole. A further object is to provide means whereby the device may be adjusted for use in connection with holes of various sizes.

ROTARY GLASS CUTTER.—C. F. Doerr, 260 W. Broadway, New York, N. Y. The object of the invention is to provide an implement for use by glaziers, in the form of a rotary glass cutter arranged to enable the user to readily adjust the cutter for cutting glass disks of any desired diameter. Another object is to prevent accidental shifting of the base of the glass during the cutting operation, and to prevent binding of the cutter bar, and to insure easy running of the revoluble cutter on the glass.

CLAMPING DEVICE.—J. MATTSON, 153 W. Chestnut St., Chicago, Ill. Among the objects of the invention is to provide a clamping device embodying a bolt-and-nut mechanism adapted to engage with opposite surfaces of the work engaged, so as to be locked in adjusted positions relative to one another and to the work. A further object is to provide a device which is simple in construction, practical, and inexpensive to manufacture.

WRENCH.—J. C. MAHAN, Lincoln, Neb. The invention has for its object to provide a wrench especially adapted for twisting together wire cables in woven wire fences, and drawing cables around the ends of corner posts, wherein a head is provided consisting of sections hinged together and adapted to embrace the wires together with jaws for rotatably engaging the head, and having interengaging means for constraining the head to turn in one direction when the jaws are vibrated. (See Fig. 13.)

GASOLINE SOLDERING IRON.—W. COHEN, 68 W. 17th St., Bayonne, N. J. The invention relates to a soldering iron wherein the iron is maintained continuously heated through the action of a flame. Another object is to provide an iron in which a reservoir, a torch and connecting parts are provided for maintaining the flame, the arrangement being such that any desired pressure of fuel on the torch may be secured. In this self-heating iron the reservoir acts as a handle.

CORNER BRACE.—W. R. KROPF, 704 Bryant St., San Francisco, Cal. This corner brace while capable of general application to wood and like structures, is particularly adapted for use on furniture. It is produced from a sheet metal blank and includes a tongue made to be embedded in the post of a corner joint, and nail or screw holds are provided. The device, while very simple, may be made to provide many different angular tie pieces.

SOLDERING IRON.—H. F. HAMMOND, General Delivery, Rutland, Vt. An object of the invention is to provide a soldering iron having connection between the iron proper and the shank or handle supporting the same, whereby the iron may be located in alinement with the shank or at different angles relative to the shank, and be firmly supported and automatically held in any of its positions of adjustment, and manually shifted from one to another. (See Fig. 14.)

WRENCH.—B. W. HANLE, 208 Chestnut St., Roselle Park, N. J. This invention is primarily designed for use as a jar cap wrench for opening jars having circular tops. The object is to provide a resilient cap band having an elastic gripping means in conjunction therewith and a handle, said handle being provided with means which cooperate with the band to decrease its diameter to cause it to grip the jar cap.

VIGNETTING TOOL.—W. J. MCCARTHY, P. O. Box 47, Rochelle Park, N. J. The invention relates to vignetting or scraping tools for use by photoengravers, and has for its object the provision of a simple, strong and economically manufactured tool which is so constructed with cutting teeth as to enable it to be pushed in stroking the plate, applying greater pressure at the end of the stroke than at the beginning, thus producing the desired vignette effect.

POCKETKNIFE.—J. JOHNSON, Box 212, Ramsay, Mich. The object of the invention is to provide a knife wherein a handle is provided, consisting of a sheath, and having means therein for engaging interchangeable tools, as, for instance, cutting blades, screwdrivers, files and the like, and for holding said tools firmly in place, either extended in position for use, or within the sheath.

WRENCH.—O. M. WHITE and W. C. MCCULLOUGH, c/o D. S. Cox, 518 Baltimore St., Muskogee, Okla. Among the objects of the invention is to provide a wrench especially adapted for removing bits from drill stems, wherein a bit-engaging portion is provided, and an operating means for rotating the same in the form of an annulus having a hinged section for permitting the entrance of the stem to the bit-engaging portion and separated from the bit-engaging portion by a ball-bearing upon which the said portion moves.

PRUNING SAW.—A. SLOTHOWER, R. R. No. 1, Vancouver, Wash. The invention relates to pruning saws with long handle particularly designed for use in sawing limbs of trees which are not accessible with an ordinary saw, the device being adapted for use in cutting green wood at high elevations, for topping and pruning trees, and particularly by exerting a pulling action upon the saw cut.

Heating and Lighting

HEATING DEVICE.—D. GRIFFITH, 2009 So. Vermont Ave., Los Angeles, Calif. The invention has for its object to provide apparatus for use in connection with stoves and the like for permitting a large amount of the heat usually wasted to be utilized, to heat the room in which the fire is arranged, or to heat other rooms, by the arrangement of a damper in the flue the heat is diverted into a chamber or drum in the room above, through which it passes and again enters the flue. (See Fig. 15.)

HEATER.—L. F. CLAUSING, 238 Van Ness Ave., San Francisco, Calif. Among the objects of the invention is to provide a gas heater that has a maximum amount of radiatory surface in as little space as possible, in which the burned gas comes in nowise in contact with the air of the room to be heated, but is only used to heat a large radiatory surface, and is then guided into a smokestack.

METHOD AND APPARATUS FOR SMELTING ORES.—V. PAZOSYSACIO, c/o Percevean Consul, 36 Ocean St., London, England. The invention particularly relates to a furnace of the shaft type, which is applicable to high altitude smelting. The above object is accomplished by providing a furnace constructed so that the fuel and gases may be burned under a pressure automatically maintained, thus eliminating in a great part the difficulties encountered in fluxing highly refractory metal.

SULFUR-BURNING APPARATUS.—H. D. WELLS, Glens Falls, N. Y. An object of the invention is to provide a brimstone-burning apparatus for use in producing sulfur dioxide gas. Another object is to provide an apparatus of this type which has a large capacity, occupies small floor space, produces a steady uniform gas of any desired composition, which unites in one machine a melting tank, a device for automatically feeding molten sulfur, and a stoker feed for emergency, reducing the cost of power, wear and labor to a minimum.

OIL-BURNING APPARATUS.—A. P. BROOMELL, deceased, address Janet L. Broomell, executrix, c/o Vapor Heating Co., York, Pa. The invention relates to oil-burning apparatus especially designed for use in connection with a boiler, the purpose being the provision of an apparatus having pneumatic means for feeding oil at the burner of the apparatus under pressure and

delivering a blast of air to the burner to effect atomization of the oil to produce a highly combustible mixture.

PRESSURE-CONTROLLED CUT-OFF.—M. L. DAVIS and G. W. COOK, Box 766, Enid, Okla. Among the foremost objects of the invention is to provide a cut-off adapted more particularly for use in connection with gas stoves, gas lighting systems and the like, automatically cutting off the flow of gas when it falls below a predetermined pressure, and becoming locked in the cut-off position so as to temporarily prevent the gas from flowing into the pipe system when the pressure returns.

MELTING POT.—J. B. MCCLAIN, 893 4th Ave., Brooklyn, N. Y. The invention relates to melting pots especially designed for reducing aluminum, Babbitt metal, solder, or other analogous soft metal. One of the principal objects is to provide a pot which includes means by which the molten metal may be drawn off from the bottom of the bowl, to eliminate the necessity of ladling the same therefrom.

FUEL FEED FOR HEATING DEVICES.—F. S. SEYMOUR, Manchester, Iowa. An object of the invention is to provide means for gravitationally feeding soft coal impregnated with moisture into the fire pot whereby the combustion of the coal is retarded above the normal level of incandescence and yet increased heat is produced at the point of incandescence, the coal feeding into the fire box in such manner that a slow burning fire of intense heat is produced.

KITCHEN RANGE.—A. E. LUNDBERG, Stockholm, P. B., Sweden. This invention relates to a range with a fireplace located over the oven, and so arranged that the flue-gases are carried off on both sides over the walls of the fireplace and downward along the two side walls of the stove and further under the bottom of the stove to an outlet for the flue-gases. The range is combined with a water heater so arranged that the flue-gases sweep around it on all sides.

Machines and Mechanical Devices

DRILL-GRINDING MACHINE.—D. A. WALLACE, 508 Frederick St., Waterloo, Iowa. The invention relates to a machine adapted to sharpen the point of a drill, and more particularly to a machine which shall sharpen a multi-lipped drill in such manner that the angle of both lips or cutting edges will be equal. A further object is the provision of a device by means of which a cutting edge will be formed which shall gradually follow the curve of the "backing" of the drill point.

TANNING MILL.—H. A. STEIN, Georgetown, Minn. The object of the invention is to provide a grain cleaner which may be adapted to the cleaning of all ordinary grains by the changing of sieves. This is accomplished by first passing the grain through a grating against an air blast for carrying away all dirt, and then passing the grain over a plurality of overlapping sieves against which an air blast is directed, and finally over a screen.

PORTABLE CRANE.—E. H. KELLEY and G. A. STEWART, JR., 728 Water St., South Brownville, Pa. An important object of the invention to the provision of a portable crane adapted for use in removing the wheels of vehicle trucks in such a manner that the bearings will not be damaged in any way. The crane may be adjusted for use in connection with wheels of various sizes, and may be easily operated by one man.

ATTACHMENT FOR MOTOR DRIVEN DEVICES.—A. G. BLOCKER, 4131 Kennedy Ave., c/o M. Schenk, St. Louis, Mo. A purpose of the invention is the provision of an attachment to motor driven meat grinders and the like, by means of which it is converted into a grinding device for the sharpening of butchers' implements. The rotational speed is delivered in such a manner as to allow of the operation of various devices other than tool sharpening.

GEARING ATTACHMENT FOR CLOTHES WRINGER.—E. ARTHURS, 1016 Gallia St., Portsmouth, Ohio. The invention relates to a power-transmitting gearing, an object to provide a gearing unit in the form of a casing which is simple and may be readily attached to and detached from any type of clothes wringer, whereby the labor of operating a wringer is considerably reduced.

GRINDING MACHINE.—W. J. COLLINS, c/o F. C. Close, Close Lumber Co., 2 Rector St., New York, N. Y. The invention pertains to a machine especially adapted for the grinding of valves. An object is to provide means whereby the valve to be ground may be adjusted relatively to the grinding element in order that seats of various angles may be ground upon the valve. A further object is to provide means whereby an internal combustion motor or similar machine may be ground by use of the same device and have contacting seats of different angles.

PEDAL CONTROL LIQUID MIXER.—W. MEIER, 2052 7th Ave., New York, N. Y. This invention relates more particularly to a device for mixing hot and cold water, the means being controlled by a foot pedal whereby the water may be mixed and maintained at a desired temperature. The device is adapted for use by dentists and others, who, while working with their hands may control the water without interrupting their work.

MACHINE FOR FORMING PLASTIC TILE.—H. BROCK, 4434 Hunt Ave., St. Louis, Mo. The invention relates generally to the manufacture of plastic tile or shingles for roofing and similar purposes and more particularly to a machine which will form and deliver plastic bodies in shape ready for drying, the prime object being to provide a machine which will continuously operate to accomplish the bulk of the work in a wholly mechanical manner and reduce to a minimum the necessity of manual efforts or skilled labor.

FLOTATION APPARATUS.—A. W. FAREENWALD, 714 So. Washington St., Moscow, Idaho. The purpose of the invention is to provide a flotation apparatus for recovering valuable mineral from their ores, which maintains the ore pulp in continuous circulation, at the same time subjecting it to aeration, the latter process being controllable at will so that its intensity can be increased or decreased in accordance with the particular character of pulp being treated.

SAMPLING APPARATUS.—R. L. BRUNER, 4007 8th Court So., Birmingham, Ala. The object of the invention is to provide a sampling apparatus especially adapted for use with conveyors or similar conduits which when associated with the conveyor or conduit is adapted to automatically obtain a fair average sample of the fluent material which is being carried through the conduit.

POST FOR WELL-DIGGING ROTARIES.—J. O. BENNETT, 816 West Ave., El Dorado, Ark. The invention has for its object to provide a post of the type designated "back-up posts" for rotary drilling rigs for drilling wells, whereby it is not necessary to remove the post when taking off the tongs, the post consisting of hinged sections, one of which is adapted to swing on the other, means being provided for holding the movable section in alinement with the body of the post.

PISTON RING.—H. STOFFERS, 471 So. 14th St., Newark, N. J. An object of the invention is to provide a ring which is so constructed as to prevent the formation of hardened spots on the bearing face of the ring which co-acts with the cylinder walls. Another object is the provision of a form of hammered ring which does not materially add to the expense of production nor increase the labor incident thereto.

AMALGAMATOR.—H. LOEVEN, 860 16th St., Douglas, Arizona. The purpose of the invention is the provision of an amalgamator for the recovery of gold from ore pulp, in which the pulp is treated within a rotated vessel which is disposed on an incline and is provided with a series of compartments through which the pulp is successively fed to effect a complete recovery of the gold.

ROUND-BALE COTTON PRESS.—H. A. W. HOWCOTT, 313 St. Charles St., New Orleans, La. The object of the invention is to provide a cotton press which is adapted to receive the ordinary square or oblong bales of compressed cotton and to apply additional pressure laterally and longitudinally for reducing the size of the bales and to cause the same to assume a cylindrical shape, as well as to facilitate tying of the bale when held in the press.

ROLLER BEARING.—W. S. HALSEY, Hotel Dover, Dover, N. J. An object of the invention is to provide an anti-friction bearing of the roller type, having means within itself for holding it at any fixed point on the shaft and within its housing. A further object is to provide a bearing in which the removing and the replacement may be readily accomplished with the use of ordinary tools. A still further object is to provide a bearing which will positively prevent the rollers from traveling axially of the shaft.

JACQUARD LINK AND DRUM.—G. C. L. TISCH, c/o Tisch Machine & Tool Works, 452 Spring St., Elizabeth, N. J. The invention relates to jacquard mechanism, particularly to the link and driving drum, and has for its object to provide a construction wherein the links will be held against lateral movement as they pass around the drum. Another object is to provide a jacquard link formed with guiding and steadying grooves together with bracing-bar extensions, the drum being formed with guiding grooves to permit interlocking action.

VARIABLE-STROKE HYDRAULIC PUMP.—C. L. BOISSET, 5116 Camp St., New Orleans, La. One of the foremost objects of this invention is to provide a uniformly driven variable-stroke pump of a very simple construction, for varying the piston stroke without shock or jar, thereby enabling an easy progression from one speed to another throughout the range of speeds, and to provide a pressure relief device to make the fluid outlet valves close promptly.

PORTABLE LOCOMOTIVE JOURNAL TURNING MACHINE.—C. E. MARSH, 324 Kemphill Ave., Atlanta, Ga. The foremost object of the invention is to provide a portable turning machine for use in truing locomotive and car journals, crank pins, etc. A further object is to provide a machine which can be applied without removing the wheels, and whereby pressure is uniformly applied to the axle on which the machine is mounted. The machine is capable of use on different sizes of axles.

SHUTTLE THROWING MECHANISM.—C. H. STRALUCKE, c/o Gen. P. O., Room 130, Transportation Department, New York, N. Y. An object of the invention is to provide a construction which may be applied to various forms of looms now in common use without materially changing any part of the loom and permitting the usual throw arms to be dispensed with. Another object is to provide mechanism automatically operable which will throw the shuttle without the use of the ordinary picker arms.

REWINDING APPARATUS.—C. DI COMO, 38 Irving St., Rahway, N. J. This invention relates to rewinding devices for use by barbers for rewinding paper and has for its object to provide a device which is simple and will readily rewind paper according to the desire of the operator. Another object is to provide a device which will act to provide a number of small rolls from a large roll of paper, the arrangement permitting an easy removal of the rewound rolls.

CONFECTION MAKING APPARATUS.—T. BOSSHARD, 385 Cornelia St., Brooklyn, N. Y. More particularly the invention aims to provide a device by means of which articles such as cherries, may be quickly arranged in trays so that they may be subsequently filled. A further object is the construction of an apparatus by means of which a single operator may manipulate the entire machine in such manner that such articles as cherries may be automatically arranged on the tray.

WINDING DEVICE.—V. E. EXTROM, 4035 Blaisdell Ave., Minneapolis, Minn. The invention aims to provide an automatic winding device, for use in connection with winding spring motors, such as are used with clocks, which shall be electrically operated and at all times insure a tensioning of the spring of a mechanical motor upon the same becoming unwound, and a cessation of the tensioning function upon the spring having been tensioned to a predetermined point.

WATCH.—H. N. HILL, Belmond, Iowa. This invention particularly relates to means for supplying the balance staff and balance jewels. An object is to provide means for supporting the balance staff so that when the watch drops or is subjected to hard usage the bearings or jewels will be permitted to move slightly and thereby cushion the shock on the balance staff and jewels for protecting the same from breakage.

INJECTOR VALVE.—L. A. FAUST, 142 Camden St., Rochelle Park, N. J. The invention relates to injector valves for boilers and particularly to means for holding certain of the valve members against coming loose. The object is to provide a series of locking means in connection with an injector valve structure whereby the valve structure must continually act in its proper capacity.

CONFECTION COATING MACHINE.—V. MATRANGA, Decd., address Vincenza Matranga, 514 Hackensack Plank Road, Union Hill, N. J. An object of the invention is to provide mechanism for subjecting submerging cakes, candies and similar confections to be coated in the material with which they are to be coated, and maintain the same momentarily submerged. A still further object is to so construct the device that it may be used on machines as at present employed.

ATTACHMENT FOR PAPER MACHINE DRIERS.—J. W. SMITH, 63 Saratoga St., Cohoes, N. Y. The invention relates to the attachment provided on paper-machine driers for affording a steam inlet to the drier and an outlet from the drier for condensed moisture. The invention is applicable to any style of drier both of the dipper type and the stationary siphon type.

BINDING MACHINE.—G. ARDIZZONI, c/o Cocona Provision Co., 132 King St., New York, N. Y. An object of the invention is to construct a machine which is more particularly adapted for use in connection with the binding of meats, such as sausages, and by means of which the binding element will be disposed with extreme neatness, and may be readily manipulated to apply the proper tension while holding the parts of the meat in proper position.

ORE CONCENTRATOR.—R. LE ROY, Basin, Mont. Among the objects of this invention is to provide means whereby a concentrator trough is rocked by a suitable power mechanism to produce a highly efficient concentration of the ore with a minimum expenditure of time and labor. A further object resides in the provision of means whereby the concentrates can be very easily removed.

PORTABLE SANDING, ABRADING AND POLISHING MACHINE.—M. N. PRANGE, 237 S. Main St., St. Mary's, Ohio. The invention relates to surfacing machines for surfacing floors, also furniture and automobile bodies. It is the primary object to provide a plurality of surfacing elements, the operating face of which may be provided with any suitable element, such as sandpaper, brushes or the like. The device is capable of movement over the surface to be operated upon, and is operated by a single power unit.

RIVET-FEEDING MECHANISM.—A. F. RENAUD, 4903 Dryddes St., New Orleans, La. An important object is to provide a rivet-feeding mechanism which is readily adjustable for feeding rivets, either single or in pairs, for splicing iron bands, where two previously punched band ends can be brought together in overlapping relation, with the openings engaged over the rivet shanks, the said band ends affording means for stripping the rivets from the feeding mechanism and positioning them under the riveting head of the press.

ORE JIG.—F. DE MIER, 201 Vantage St., Picher, Okla. The inventjon relates to a jig which eliminates the employment of water as a separating medium. A purpose is to provide a jig in which the screened bottoms of the cells are all on one and the same level and which includes a plurality of rakes mounted for curvilinear movements and simultaneously, by a single actuating means, to effect the successive raking of the material from one cell to the other.

PATTERN TRANSFER MACHINE.—P. YOHNS, 306 W. 12th St., New York, N. Y. The invention aims to provide a machine by means of which patterns, such as embroidery patterns, may be transferred from a master pattern to those patterns used by needle workers, in an economical manner. Another object is the provision of a machine by means of which it is possible to turn out transfer patterns at a fast rate of speed, and to enable the master pattern to be used a maximum number of times without becoming in the slightest damaged.

MACHINE FOR MAKING SPRINGS.—R. D. REESE, 510 11th St., So., Virginia, Minn. The invention has for its object to provide a machine especially adapted for making springs for use in the Sullivan jack hammer drills. The machine comprises a shaft forked at one end, having a disk supported by the fork in a plane at right angles to the axis of the shaft, means for turning the shaft, and a headed pin detachably connected with the disk at the center.

SPROCKET WHEEL.—R. J. RILEY, 18 College St., Portland, Me. The invention relates to a sprocket wheel having pockets spaced apart and cut from its periphery inwardly, and between said pockets an annular channel for receiving a cable to which buttons are secured and adapted to drop into said pockets. An object is to provide shoes to be secured to the sprocket wheel

at the points of contact of the buttons, the shoes are readily replacable, and will free the sprocket wheel from wearing.

PIN GUIDE.—G. C. L. TISCH, 452 Spring St., Elizabeth, N. J. This invention relates to pin guides for knitting machines and has for an object to provide a guiding structure for pins which will hold the returning pins in substantially a desirable position and will then reassemble or shift all the pins, regardless of their position, to a given starting point.

SORTING MACHINE.—A. VAN COTT and J. EVANS, c/o Albert Van Cott, 625 S. State St., Salt Lake City, Utah. The invention aims to produce a sorting machine particularly adapted for use in connection with the sorting of garments in commercial laundries. An object is to produce a machine by means of which, aside from the fact that but a minimum of space will be occupied, one operator is capable of handling the work usually requiring the services of two or more.

SAFETY DEVICE FOR ELEVATORS.—H. MCGILLIVRAY, 508 W. 23rd St., New York, N. Y. The object of this invention is to provide means automatically operative to cut off the power and stop an elevator and counterweights in event of the breaking of the cables by which the same is supported. A further object is to provide pivoted levers with cammed extremities which are adapted to be thrown to active position by means of springs, means being provided to relieve the springs of wear when in machine position.

STAMP.—O. B. PICKERING, 111 Jefferson Ave., Endicott, N. Y. An object of the invention is to provide a stamp in which the die-carrying hammer is adjustably supported, whereby the device is suitable for use in stamping flat pieces of work, such as hides and pieces of leather, which vary in thickness. A further object is to provide a device having means for stamping and counting at the same time, and made of non-ferrous material to withstand chemical action.

COMBINATION PLATE AND THREAD GUIDE.—G. C. L. TISCH, 39 Orchard St., Elizabeth, N. J. The invention relates to attachments for the thread bar of a knitting machine. An object is to provide a construction in the nature of a thread guide wherein the tube may be applied and removed quickly. Another object is to provide a thread guide designed to carry one or more tubes and be held in place by a single clamping member.

BUSHING INSERTER OR REMOVER.—O. F. TIMM, c/o Wilson Creek Garage, Wilson Creek, Wash. This invention relates to bushing inserters and removers for use with machine bearings or the like, and has for its object to provide a device which is effective to speedily insert or remove the bushing without distorting or injuring it, and without impairing the machine with which it is associated and which in some instances is capable of carrying out the operations without disassembling the machine.

CALCULATING MACHINE.—R. T. PISCICELLI, 6 Rue de Hanovre, Paris, France. The invention relates to a multiplying and adding machine, the multiplication being made by repeated additions and addition by adding the different products obtained, the machine being characterized by an electric motor within the machine; the totalizing discs remaining fixed instead of being displaced with a carriage; the addition of the different products obtained is only effected at will, and the return to zero of the multiplicator and product indicator is automatically effected when adding each product obtained on the totalizing device.

STAMP AFFIXING MACHINE.—A. and J. VILLANI, address Anthony Villani, 137 Union Ave., Brooklyn, N. Y. This invention relates to a machine for affixing stamps to envelopes or for performing a similar operation, and has for its general object to provide a machine in which by simple mechanism the stamps will be unfailingly fed in succession from a reel to an affixing plunger and the operations of feeding and affixing be automatically timed with accuracy.

LIFTING DEVICE.—L. WILKINSON, Box 66, Sour Lake, Texas. An important object is to provide a device for use in lowering and elevating pipes in wells, embodying a pair of gripping sections having means whereby the same may be detachably secured to a well pipe so that the well pipe may be raised or lowered without the possibility of the device becoming accidentally disconnected.

PISTON PACKING.—J. P. SIMPSON, c/o U. S. S. Cockoponset, U. S. Shipping Board, Brooklyn, N. Y. This invention relates to a packing for pistons and similar devices, and has for an object the provision of a simple, strong, easily operated mechanism whereby the packing in the piston may be adjusted to continually tightly fit within the cylinder wall without replacing the packing.

COMPRESSOR OR VACUUM PUMP.—R. N. TRANE, c/o The Trane Co., La Crosse, Wis. An object of the invention is to provide a device which can be used either as a compressor or vacuum pump, in which the air is drawn into a casing by means of an impeller, and is forced therefrom through an outlet in a compressed condition through the medium of a liquid such as water, the proper amount of water being automatically maintained.

CENTRIFUGAL PUMP.—R. N. TRANE, c/o The Trane Co., La Crosse, Wis. Among the objects of the invention is to provide a pump in which friction is reduced to a minimum, at the same time it is possible to pump higher pressures than can be ordinarily obtained with a single stage centrifugal pump, it being possible in this construction to increase the number of stages. A further object is to provide means to increase or decrease the pressure by changing the ratio of the area of the blades of the impeller.

Medical Devices

MEDICAL APPLIANCE.—L. A. HALL, 30 Central Sq., Keene, N. H. The invention relates to a medical appliance to be used on the body, in the place of massaging over the surface of the intestinal cavities, by means of the appliance continued pressure will be exerted over the sigmoid flexure, the descending colon, the ascending colon, and over the calcum where the appendix is situated.

SURGICAL INSTRUMENT.—A. B. COUCH, cor. Coleman and Railroad Sts., Merlin, Texas. This invention relates to an instrument for use in performing the operation of circumcision and has for its general object to provide an instrument whereby the operation may be quickly performed without injury and essentially without pain and bloodlessly.

DENTURE AND METHOD OF APPLICATION.—A. PIMIENTA, 210 W. 70th St., New York, N. Y. The invention has for its object to provide a denture and method of application whereby misshaped mouths and misplaced teeth may be adjusted or compensated for. Another object is to correct the appearance of the mouth and face where a person has either protruding teeth and to give the rounded appearance to the face of correctly fitting teeth.

VACUUM VIBRATOR.—J. G. STEPHENSON and F. W. NUERWELL, address F. W. Nuerwell, 11 E. 7th St., Tulsa, Okla. The object of the invention is to provide a device having kinesi-therapeutic properties and which is especially designed for improving the general health by correcting poor circulation, the apparatus operating to this end by inducing a flow of blood and other vital fluids to and through such parts of the body as may be poorly nourished.

STERILIZER FOR INSTRUMENTS AND DRESSINGS.—O. BARTA, 425 East 78th St., New York, N. Y. The object of this invention is to provide a sterilizer for surgical, dental, and other instruments and dressings, and arranged to insure a thorough sterilizing of the instruments and dressings, and to properly dry the dressings, and to allow of readily placing and removing the articles after they are sterilized, and to utilize the same source of heat for sterilizing both articles.

Prime Movers and Their Accessories

MOTOR.—L. WATKINS, 237 North Boulevard, Baton Rouge, La. More particularly this invention relates to rotary fluid motors as applied to a motor or a pump, an object being to provide a construction and arrangement of motor casing, or stator, and rotor with cooperating parts whereby a maximum of efficiency is obtained. In operation the fluid entering and escaping through manifolds will exert pressure on the blades and cause the rotary elements to move.

VAPORIZING DEVICE FOR FUEL OIL.—R. L. BOWMAN, R.F.D., No. 5, Knoxville, Tenn. The invention relates to a device for vaporizing kerosene for use in connection with internal combustion engines. An object is to provide a device which may be used in connection with any ordinary carburetor, which may be initially operated by means of a storage battery, or other suitable source of current. A further object is to provide a vaporizing unit which may be inserted in the intake manifold wall, after the manner of a spark plug.

INTERNAL COMBUSTION ENGINE.—G. B. GERAU, 1494 E. 115th St., Cleveland, Ohio. One of the foremost objects of the invention is to provide a multi-cylinder two-cycle engine, so arranged that the influx of a new charge is not depended on to scavenge the cylinder of a previously burnt charge. Another object is to provide an engine which employs a trunk piston having a main head operating in the explosion chamber, an auxiliary head operating in a combined air and gas pumping chamber, the air pumping action occurring near the end of a working stroke to scavenge the explosion chamber of the burnt gas before the new charge is let in.

PISTON LOCATER.—A. KLIGGE, 4905 3rd Ave., Brooklyn, N. Y. The general object of the invention is the provision of means that may be used in conjunction with an internal combustion engine cylinder to determine when the piston has reached dead center in order to adjust the timing apparatus. This object is accomplished by providing indicating means, and means for allowing the air to escape after it reaches a certain pressure. (See Fig. 16.)

ATTACHMENT FOR CARBURETORS.—L. F. LIESER, Sidney, Ohio. More particularly the invention relates to mixture-controlling devices, the object being the provision of a simple inexpensive automatic fuel valve whereby to allow for a rich mixture for starting purposes when the parts are cold, and to automatically taper off to a comparatively lean mixture when the parts become warmed up after starting; the device is capable of ready installation and quick, easy adjustment. (See Fig. 17.)

Railways and Their Accessories

CAR TRUCK.—S. B. BRILHART, 214 W. 127th St., New York, N. Y. The invention has for its object to provide an arrangement of trucks which will properly support the car and which will operate regardless of the curvature of the track. A further object is to provide a jointed car structure wherein special arrangements are provided at each of the end truck sections for permitting ready turning action which will co-act with the central or connecting truck sections.

MINING CAR.—W. KIRCHMAN, c/o Engineering Works, Van Buren, Ark. The object of the invention is to provide a car which is made up of standard units and sections, such units and sections being adapted for casting or otherwise forming previous to their assembly for forming the car. It is also an object that the sections forming the body of the car be adapted for varying the width thereof. The different sections are secured together by means of bolts, and a broken unit may be quickly substituted.

FRICTION COMPOSITION AND PROCESS OF MAKING SAME.—W. ACHTMEYER, 29 Silver St., Middletown, Conn. The invention relates to friction devices such as brake-shoes and linings for heavy vehicles, railroad cars, or machinery. The object is the provision of a brake-shoe which possesses a high coefficient of friction, and a smooth, gradually increasing action and which have a high temperature of carbonization and are unaffected by water, oil and heat. The friction member comprises asbestos impregnated with a condensation product of phenol and methylene-diphenyl-diamine.

AUTOMATIC TRAIN CONTROL.—F. C. GRAF and M. J. ZWOSTA, 417 Autumn Ave., Brooklyn, N. Y. The invention relates to a system which is operable in conjunction with the signal systems now in use, or may be independently operated by a separate system with equal efficiency. It is one of the specific objects to resort to means operating in conjunction with the air brake system, and to provide an automatic system which entirely eliminates the failure on part of the human element. (See Fig. 18.)

Pertaining to Vehicles

GEAR SHIFTER.—W. G. STEVENS, JR., 4019 Swiss Ave., Dallas, Texas. Among the foremost objects of the invention is to provide a gear shifting mechanism which is almost wholly actuated by the exhaust gas of the motor, to provide means for utilizing exhaust gas pressure to first neutralize the transmission gears, disengage the driving clutch and finally shift the gears to the proper combination, in order to obtain the desired speed. Certain steps in the operation are accomplished by the brief use of electricity, all the speed changing being actuated by push buttons. (See Fig. 19.)

PERMUTATION LOCK FOR AUTOMOBILES.—A. P. LITREM, 48 Rue Crosatier, Paris, France. The invention relates particularly to a lock which is applicable to the steering gear of an automobile. The device is essentially characterized by a bolt carried by the outer tube of the steering gear, this bolt may be engaged in the tube or rod integral with the steering pillar and is

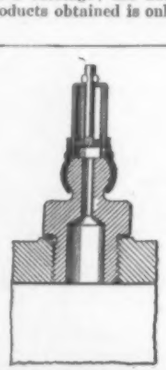


Fig. 16: Piston dead-center locater devised by A. Kligge

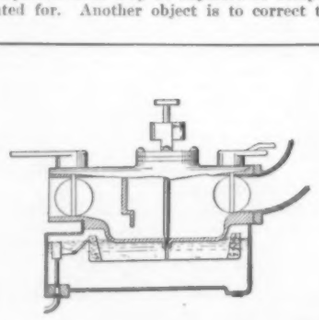


Fig. 17: L. F. Lieser's carburetor-control attachment

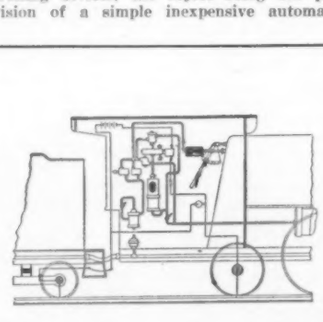


Fig. 18: Automatic train-control system invented by F. C. Graf and M. J. Zwosta

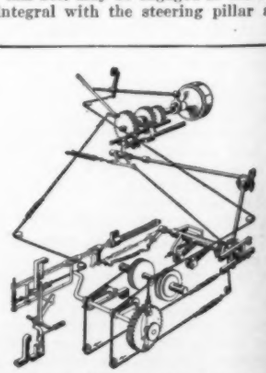


Fig. 19: Gear shifter operated mainly by exhaust gas, patented by W. G. Stevens, Jr.

Science Notes

Further Gifts to Mme. Curie.—When Mr. Donn Barber sailed recently he took with him a set of instruments valued at $30,000 for the use of Mme. Curie. They were paid for by the excess funds raised by the committee.

Paper from Eucalyptus.—Experiments in West Australia indicate that paper of good quality can be made from the common eucalyptus. Government and private interests have raised capital for plants and machinery.

Prohibition Reaches Tobacco.—The prohibition of smoking is an accomplished fact, at least as applied to the cyclone-swept 540,000 acres of the Olympic National Forest. This taboo was proclaimed by the Secretary of Agriculture to protect the timber.

A Cloud of Locusts that actually darkened the sun is reported in the Orenburg region, Russia. In several districts grass and grain have disappeared. The dispatch adds that human locusts, working on food trains in the famine belt, have made away with thousands of poods of provisions; fifty-six have been sentenced to death and a thousand others to prison terms.

Steinach Process to Be Shown in Film.—The postponement of the infirmities of old age is to be shown in the film with Dr. Eugen Steinach, the noted Viennese biologist. The Berlin film company, which has filmed illustrations of the Einstein theory, is attempting this newest scientific demonstration. Professor Steinach's experiments with rats and serums, drawn from their young, led to the application of the same principle to human beings.

Arctic Owls Move Southward.—The Puget Sound region has for the first time in 25 years been invaded by the great Snowy Owl of the Arctic. This owl lives on small mammals that have been driven south by excessively severe weather, and it may have followed them into the United States in search of food; the bloodstained feathers and fur of its prey may be seen in every part of the region. These giant owls, sometimes measuring 6 feet across the spread of the wings, have been known to attack a man.

Blue Caterpillars are Found.—While breeding butterflies in his laboratory, Dr. J. H. Gerould of Dartmouth College discovered a number of blue caterpillars. They were found to breed true, and the color is probably the result of some mutation in the digestive system. So conspicuous are they against green leaves that sparrows pick them off while overlooking their green relatives, and it is likely that blue caterpillars have always existed, but that the birds have discovered them before man could do so.

Another German Has a Freak Memory.—Herr Otto Schrader of Berlin is the possessor of an extraordinary memory. The German Meteorological Society tested it recently. "What was the weather on November 26, 1890?" Schrader was asked. "It was clear before dawn; in the afternoon it became cloudy, with snow flurries. The temperature was two or three degrees above freezing point," answered Schrader. The scientists checked him up and found that he was right.

Blind Insects Damage Poles.—The latest enemies of the public utility company are insects. Blind ants and carpenter bees are engaging the attention of electrical men throughout the country. The insects are causing much damage to electric light poles. They enter the pole below the ground, eating their way through poles all the way to the top. Being blind, they instinctively seem to shun the light and confine their operations beneath the surface. Methods of checking the devastation are being considered.

Disease-Resistant Chestnut Trees.—J. F. Rock, who gave 11 months' study in the Far East to the chaulmoogra tree, source of the leprosy cure, has gone back, partly to continue these studies, but chiefly to investigate economically valuable plants, and particularly to observe the chestnut trees of southeastern Asia, where there are more species than in all the rest of the world. The American chestnut is rapidly dying out, and there are grounds for hope that by making hybrids between American and Asiatic chestnuts we may find a disease-resistant forest tree to replace our native chestnut.

Eastern Braille for the Blind.—The idea of what is known as "Eastern Braille" was originated by two priests who are devoting their lives to this work, Father Cantonnet and Canon Nouet. The ordinary Braille system, apart from the difficulty in

reading, even by the skilled, is not valuable for communicating between blind and normal writers. The Cantonnet-Nouet system follows more nearly the synthetic forms of the Latin alphabet, some letters, such as those composed of straight strokes, remaining unchanged. Experience has shown that a student can learn the reading of the new characters in less than a month, as the angles appeal quickly to the sense of touch.

The Radium Ores of Jachymov.—Government-owned mines at Jachymov, Bohemia, are turning out uranium ore rich in radium and the known supply is said to be sufficient for 20 years at the present rate of production; in addition, there are three large mines not yet prospected as to depth. Two grams of radium a year are now being produced and net profits to the Czechoslovak Republic for the past year were about 3,500,000 crowns. The radium is selling today at 10,000,000 crowns per gram, a crown being now worth about 1.94 cents. While production in the United States is greater in quantity, the Jachymov ores are reputed to be richer in quality.

Low-Grade Tungsten Ores.—Before 1907 it was thought that tungsten minerals were found only in veins and pegmatite bodies, but since then scheelite was discovered as a minor mineral in contact-metamorphic deposits in such widely separated places as Japan, Finland, Alaska and Nevada. The advent of the war and the consequent rise in price made these low-grade deposits workable at a profit, and by 1919 they were contributing a large part of the world's supply. Wolfram and the other original tungsten minerals are wholly unknown in this type of deposit, which is formed through the alteration of limestones and other rocks by solutions accompanying granitic intrusions. The ore generally carries less than 1 per cent of tungsten trioxide.

Fixation of Nitrogen to Continue.—Now that the Research Laboratory has been transferred from the War Department to the Department of Agriculture, research work in methods of fixing nitrogen from the air will be continued. Thus, while agricultural and chemical interests will be served, all data will be available to the War Department in case of necessity. Dr. Tolman will remain as director, with a personnel of more than a hundred carefully selected workers. So far, the cyanamide, Haber, and arc processes have been studied; the first was assigned to be used at the Muscle Shoals plant; the last is regarded as most promising from a military viewpoint because of the possibilities of rapid installation; it provides nitrogen at once in the nitrate form without the need of oxidation from the ammonia form.

Radium Ore and its Exhaustion.—A correspondent of the *Engineering and Mining Journal* takes exception to a recent statement that the radium ores may be exhausted in 15 years. His survey of the fields of Colorado-Utah, the Carrizo Mountains, and New Mexico and Arizona, leads him to predict that these fields alone will far outlive the 15 years; indeed, at the present rate of production, which is hampered by shutdowns apparently designed to keep the small producer in his place, the output of Colorado ores may continue for several centuries. An addition to known mineral areas is the region lying on all but the north side of the Carrizo Mountains, where rich discoveries have been made; here, and to the west and southwest, the overburden is only 20 to 50 feet. There are also unworked deposits in the Henry Mountains of Utah. Altogether the pessimistic outlook seems unwarranted.

A Museum of Voices.—Languages and dialects, ranging from the talk of the Georgia plantation negro to the dialect spoken on the remotest island of the South Seas, and including the words of the world's most famous men, will now be preserved in the museum of voices soon to be opened in Berlin, in connection with the phonetic department of the National Library, says a cablegram from Berlin to the *New York Herald*. The collection, which is already started, is the work of Professor Wilhelm Doegen, phonetic expert. The first phonographic records include all the known dialects of the English language, and others in different tongues are to be added. General von Hindenburg and Rabindranath Tagore have registered their voices. English dialects are reproduced through the quotation of the same verse in the Bible. The records are of copper, bearing an engraved likeness of the speaker, and his autograph. Professor Doegen estimates that the records will last 10,000 years.

Miscellaneous Notes

Whitewash for Westminster Abbey.—An attempt is being made to arrest the decay of Westminster Abbey, London, by using a variety of whitewash, and a small section is now being so treated as an experiment.

A "Pay-Before-You-Leave" Telephone Booth that imprisons the user until he gets his number and until all charges have been paid, will not be installed in New York at least. The idea may be efficient, but would not be popular and such booths would probably be shunned.

Revival of Italian Coral Fishing.—The Italian coral industry was paralyzed during the war, but it is now being revived with the aid of motor boats, which will exploit the waters of Algiers, Tunis, Dalmatia, and Greece. Japan has a virtual monopoly of the industry at the present time.

Something New in Punting.—One of the dwellers on the upper Thames has invented a new punting pole of hollow, light metal, which prevents the user from getting wet or even tired. Pushing a boat through the eel-grass borders of this delightful river affords much pleasure to residents, and those who come from London for the purpose.

The Supreme Test of Honesty.—An inn keeper in Rainier National Park has devised an acid test for honesty. He exposes a stamp box with a fine assortment of stamps of various denominations, with a sign "Stamps for Sale. Help yourself and pay in coin only. Attendant will change bills." So well has the scheme worked that there has always been a balance struck at the close of the day.

A Salesroom Prison.—So many robberies have recently been committed in New York, below the so-called "dead line," that much of the diamond buying is done in small private offices whose doors close with an ominous click. When the goods have been examined, the salesman communicates with the outside office with a buzzer, and the door is opened from the outside, for the beautiful private office was to all intents and purposes a cell.

Storm King Road Finished.—After six years' work the famous Storm King Highway on Storm King Mountain on the Hudson, near Cornwall, has been completed. The new highway saves vehicles traveling between Newburgh and New York on the west side of the Hudson River from journeying around back of the mountains and shortens the route about 16 miles. With its approaches, it cost the State between $1,000,000 and $2,000,000.

A Leaning Lighthouse.—Pisa may have a leaning tower, but the Hudson River can boast a leaning lighthouse—the Rockland Lake light. The "list to port" began soon after it was built, probably by the washing out of the old oyster bed. The machinery of the light has been adjusted so that it functions properly. All the disagreeable features of the tilt come on the keepers. In time the lighthouse may be straightened up if funds are available.

A College of Domestic Service.—The servant problem is to be solved in England by a college for domestic service and the useful arts, and $250,000 has been set aside for the purpose. A graduate will not only learn about cooking, laundry work, needlework, and general housewifery, but attention is given to singing and piano playing, for the model English servant must evidently have to brighten up the long winter afternoons when the mistress cannot go out.

Movies at the Forbidden City.—An attempt is being made to show movies to the Dalai Lama, in the hope of getting permission to make film records of the country. Special films were prepared in India along similar lines, to minimize the shock of presentation. After the excellent reception given the members of the Mount Everest Expedition it really seems as though the barrier of isolation may be conquered in a short time, and Tibet and Lhassa become accessible to the serious-minded scholar, for the trip will be too difficult and expensive for the average tourist to India.

The New Venice.—Any modernization of Venice would be a profanation, yet we cannot wonder that this city with its glorious maritime traditions longs to become a world port once more. How to accomplish this without marring the beauty of the remarkable aquatic city was a problem. This danger has been happily averted by a wise governmental policy. Trade is to be diverted away from the city itself to a great new harbor, and industrial centers now be-

ing built upon the mainland at Marghera and Mestre. These points are connected with the sea by a new ship canal dredged across the lagoons in continuation of the Giudecca Canal.

Fast Ship and Airplane Service to Paris.—The White Star Line has announced that arrangements have been perfected for passengers from New York on the liners "Majestic," "Olympic" and "Homeric," landing at Cherbourg, to complete their journey to Paris from that port by airplane. Tickets will be sold at the purser's office on shipboard. Two types of airplanes will be used, one making the journey in two and a half hours and the other in two hours. The average time by train, from Cherbourg to Paris, is about seven hours, and it is a most uncomfortable ride, as the writer can testify.

Harvesting Rice in Boats.—From time immemorial the Indians of Minnesota, Wisconsin, and Canada have been harvesting wild rice by shaking or knocking the ripe grain into a boat, usually a canoe. The white men of today use the same primitive plan. The Department of Agriculture is investigating possibilities in growing the plant, and reports that it is a good food and that it has a possible value as forage. Very little of the grain ever gets on the market, as the Indians sell only the small surplus they may have occasionally. It is considered a delicacy and is sometimes served with game by the best hotels. The plant has an ornamental value that should appeal to the landscape gardener.

The Pope's New Motor.—At last the automobile has penetrated to the sacred precincts of the Vatican. The present Pontiff, who has very enlightened ideas, probably often used motors when he was Archbishop of Milan, so that when the people of that city made him a present of a mauve-colored machine adorned with the Papal coat-of-arms, he not only accepted it, but went out into his garden to see it when it arrived. He can travel 3¼ miles in his own grounds. Some of the Cardinals have had cars for a number of years. Vatican officials have remarked the change from relatively recent times when ecclesiastics were forbidden even to ride bicycles. Several Cardinals have made airplane ascensions recently and the Pope is interested, which may lead to another story.

The Bank of England to Become a Small Skyscraper.—The Bank of England is to be modernized, and the interior rebuilt to four or five stories. Will wonders ever cease? Any disruption of this essentially British institution will surely be looked upon with disfavor in many quarters. For example, the messengers still wear salmon-colored, swallow-tailed coats, scarlet waistcoats, black trousers and silk hats. The porters are garbed in crimson and gold lace. Every night since 1780 thirty-six soldiers stand guard. This was probably brought about by the Gordon Riots, so admirably described in "Barnaby Rudge." A modern banking structure will take the place of the present inner buildings. The Bank of England was built by Sir John Soane in 1788, and occupies three acres of ground in three separate parishes. Sir John Soane left his house and collection intact at No. 13 Lincoln's Inn Fields, and proof of having visited this interesting collection once is regarded as the acid test of the true Londoner.

Hegemonics.—Lieut. Colonel Jennings C. Wise, D. S. C., of the Washington Bar has added to his military writings another book, entitled "Hegemonics, or Thoughts on Leadership and Training, including The Soldier's Life in Battle." Colonel Wise is admirably qualified, from the standpoint of theory as well as of practice, to write on the duties of an officer. He approaches this phase of the subject from a new angle as regards military literature, and his book will prove of great service to the military profession and of much interest to the layman. The most readable part of the book is given up to an actual account of a battle, describing the activities of a battalion properly officered and one improperly officered. This part of the book was written at the suggestion of Major General Cronkhite, and the extended personal experience of the author, who was badly wounded at Nantillois, in some of the hardest fighting at the front, gives this section of the work its technical value and lends it a human interest note which makes the story almost as gripping as well-written fiction, notwithstanding its obvious accuracy in portraying the actual conditions of battle.

Civil Engineering Notes

German Labor for French Public Works.—A plan has been prepared by the French Minister of Public Works, under which the German Government would supply most of the materials for the improvement of navigation on the river Rhone, and for other large engineering projects. In this way Germany would make good a large part of her reparations to France. Should the scheme be put through it will put France in a strong position for future expansion of her industries.

Liverpool Dock Extension.—Facilities at the port of Liverpool are being greatly enlarged by dock improvements which are now being put through. The Gladstone dry-dock, the largest of its kind, is to be made part of a new system which will include a dock of 22 acres area, and two new branch docks of 11¾ and 13 acres area. The new system will be approached by an entrance lock 1070 feet long by 130 feet wide. The depth of the sills at low water will be 21 feet 4 inches, and at high water 48 feet 10 inches.

Coal Deposits in the Belgian Congo.—A valuable find for the future of the Belgian Congo is the discovery of large deposits of coal, one on Lake Tanganyika, and the other on the Luena. The Tanganyika deposit contains five veins, varying from 2 feet 6 inches to 5 feet 6 inches in thickness, with an aggregate thickness of 16 feet. It is estimated that these deposits contain over one billion tons of coal. The Luena deposit has a total thickness of about 21 feet, covers about 500 acres, and includes about 16,000,000 tons of coal.

Locomotive Cab Signals in France.—The French railways are called upon by the Government to equip their locomotives with a device which embodies some of the features of the so-called "automatic stop," as being now developed in this country. The equipment consists of a ramp through contact with which a whistle is blown when the signal is against the train. The device has no action on the brakes, but serves merely to add an audible signal to the visible signal at the side of the track. According to the Minister of Public Works, this installation will soon have been carried out in its entirety.

Movement in Brooklyn Bridge Towers.—To speak of elasticity in such massive stone structures as the Brooklyn Bridge towers will seem startling, at least to the lay mind; but, due to the rigidity of the saddles at the top of the towers, the springing of the towers became a necessity. Instrumental measurements have been taken of this movement, which is in the directions and of the amounts corresponding to the conditions of loading for the time being. Tall chimneys, such as the 500-foot chimney for a smelting works in Japan, have been measured for movement in heavy wind, and it is found that they possess sufficient elasticity to bend and return to their normal position.

Scandinavian Hydro-Electric Power for Denmark.—In view of the high cost of fuel, the European nations are making extensive studies of the possibility of utilizing their water powers. Denmark, a comparatively flat country and but poorly supplied with streams, is considering the possibility of transmitting power from Norway and Sweden, which are abundantly supplied with hydraulic power. In default of water power Denmark, as was shown in an article on page 184 of our September issue, has turned her attention to the development of aero-electric power. The electrification of Denmark by current from across the Baltic is being investigated by an Inter-Scandinavian Committee.

The Muscle Shoals Problem.—The Senate Committee on Agriculture, in its minority report urges the acceptance of the Henry Ford Proposal to operate the Muscle Shoals property, while it speaks in strong condemnation of Government operation, as proposed under the so-called Norris plan. Interest charge on the investment is to be eliminated by amortizing and returning the investment by means of a long-time sinking fund. The report states that the series of payments to be provided, when invested in a sinking fund at 4¼ per cent, will return the cost of both dams as well as $17,000,000 which has been spent upon them by the Government. Ultimately, the capital charge would be eliminated, and the power sold at between $1 and $3 per horsepower per year. Moreover, fertilizer costs would be materially reduced, and industrial expansion similar to that at Niagara Falls would be realized.

Safes and Safe-Breakers—II

(Continued from page 301)

Fact Versus Fiction

Here another disputed problem of safe-opening comes to mind. We are all familiar with the fictional heroes, a la Alias Jimmy Valentine, who rubbed their fingers to the quick on sandpaper and were then supposed to open safes by means of touch. It has been generally supposed that this was a purely romantic notion and that such feats could not be performed. All the yeggs I have ever consulted agreed that there was nothing to this claim and this writer has been one of the chief skeptics. Nevertheless, I have recently seen the feat performed in connection with the safes of Labor Leader Brindell in New York, who locked his strong-boxes and refused to open them. After many experts in the employ of the manufacturers had failed, an Italian safe mechanic and locksmith was summoned out of Grand Street to the District Attorney's office and he opened the safes within forty minutes, without the use of a single tool, merely by listening intently to the tumblers and employing both his sense of touch and a very complete knowledge of combinations and their number sequences. He afterwards demonstrated for me and explained how he worked. Without revealing this gentleman's business secrets, it may be said that only such combinations as have tumblers may be opened in this way and that the large bank safes are in no special danger from experts of this kind who might turn criminal.

Another invention which has figured extensively in the calculations of those whose business it is to prevent safe robberies is the automobile. When this means of rapid locomotion came into use it was expected that yeggs would adopt it and that there would be the devil to pay. But, except in isolated cases, nothing of the sort happened. The reasons are that there are too many automobiles and that pursuit and identification of a car employed by robbers in operations against country banks would be too easy. A car is too hard to hide and those escaping in it must stay on the roads, where the telegraph is certain to head them off. Overland flights afoot or recourse to the good old freight train are still the best methods known to the yegg. I believe, however, that the acetylene yeggs have employed cars to some extent, since they need a vehicle in which to transport their apparatus.

This was the situation ten or fifteen years ago: No safes had come into use among smaller banks that could not be broken with nitro, though a good many claims were made, which subsequent burglaries disproved. The acetylene torch was being rapidly introduced and safes specially built to resist its heat did nothing of the sort. (Nor have those devised in the meantime fared better.) The automobile had not been extensively used by bank robbers. Old-fashioned bank banditry or holdup was practically extinct.

The Screwdoor Safe and the Time Equation

At this point invention stepped in once more and there followed a new revolution in bank robbing from which resulted the conditions prevailing today. Safe manufacturers had seen that the only real hope of defeating the burglars lay in very large and heavy steel boxes, which because of their very ponderousness could not be opened with either nitro or the torch in the few hours allowed the robber for his work.

As a result of experimentation along this line there was gradually evolved what is commonly termed the screwdoor safe. There are various makes of this kind of strong-box and several special styles. I do not know that one is better than another and I speak of the screwdoor safe as a type, not as the product of any one maker. Such great costly safes began to find their way into the larger banks a good many years ago, but their high price kept them out of the rustic financial houses until most recent times, when the safe-makers began to construct somewhat more economical models and the bankers began to see that nothing else was worth while. Today the screwdoor safe has been introduced all over the country and banks not so equipped are rare.

The immediate result of this invention and its widespread adoption has been the nation-wide defeat of the soup yegg. To state the case accurately, the screwdoor safe can be blown with nitro. It probably can also be opened with the torch. It is not in a technical sense invulnerable, but practically it is just that. The time that would be necessary for the success of either attack

is not available between nightfall and the next morning. All bank burglars know this and they pass the screwdoor safes by.

On its face this condition means the end of the era of safe burglary by means of explosives, and there are a great many signs pointing to this development. But one who has watched the half century of conflict between the robber and the banks is not too easily convinced. It would be more conservative to say that the screwdoor safe means the end of bank burglary with such technical implements as are now in the hands of the criminals.

Some of the results of this defeat of the bank burglars are already largely and painfully apparent. The first of them was the shifting of burglarious attacks from the bank safe itself to the safe-deposit vaults, which means, of course, that the persons concerned in the losses are no longer the bankers but the clients. The deposit vaults, carefully as they may be protected in most cases, are not inclosed in screwdoor safes and the robber finds it easy enough to crack them open and attack the boxes inside with nothing more formidable than a sledge or a can-opener, an implement fashioned out of a short crowbar or jimmie and designed to cut the sheet iron or steel of safes and strongboxes as a kitchen can-opener cuts a salmon tin.

The widespread ownership of easily negotiable Liberty Bonds figured in this change of attack. The burglars have been able to count, in the last five years, on finding these bonds in almost every box they might break open, and the losses in some of these burglaries have consequently been extremely heavy. Naturally, another shift in the burglar's point of attack is involved in this change. The banks which have safe-deposit vaults are the larger institutions in major towns and cities. Consequently the old yegg has come in from the "sticks" and is once more an urban criminal.

The Bank Bandit, 1921 Model

But still more interesting, as a result of the invention and introduction of the screwdoor safe, is the revival of bank banditry, which was originated by such robbers as the Jameses, just after the Civil War, and was driven out by the telegraph and the railroad twenty years later. And a phase of this restoration that will interest inventors is the belated adoption of the automobile by criminals of this class.

Many old yeggs, unable to combat the screwdoor safes, have tossed away their rubber bottles of nitro and picked up the bandit's revolver. But, unlike their notorious forebears, they do not go after country banks and ride to cover in the wilderness of the hills and forests on horseback. Instead they raid the banks of cities, even those of New York itself (as in the Hamby case in Brooklyn, three years ago), and dash to the cover of urban jungles in motor cars.

Two representative cases will show the significant aspects of this mutation. In Detroit not long ago a gang of ex-yeggs painted up a motor car in faithful imitation of the official police cars, which are allowed the right of way over all traffic. They mounted an official police signal whistle on their counterfeit car, dressed one of their number in a policeman's uniform and drove to a bank in the heart of the business section. Here three men got out, walked into the bank, levelled revolvers at the officials, swept a big haul of cash and bonds into a bag and ran out into the street. They sprang into the car and rushed through the streets with the police whistle tooting on their dashboard and the traffic officers all along the line of their retreat holding back the other vehicles to let the "police car" flash past to the slum district of the city and immediate cover. This is but an elaboration of the plan used by Hamby in attacking the Brooklyn bank, when he hired a taxicab and kept it waiting with the engine running.

The other case in point deals with a bank at Sandy Springs, Maryland, which has been attacked five times by yeggs because of its exposed position. After the first attack the bankers took such precautions that the nocturnal burglars were driven off in four succeeding raids. But more recently, after the yeggs had turned to banditry, a gang of them invaded the town in broad daylight, held up and robbed the bank, killed an official who offered resistance and escaped with their loot. Later some of the bandits were caught and sent to prison for life.

Apparently, for the time being, the burglar has been stopped by inventions too strong for any tools now at his command. He has gone back to the primitive tactics of his ancestors until further inventions let him take the field again with a new technique.

International Fisherman's Deep-Sea Race

(*Continued from page 297*)

year will in all probability accept her entry.

In the accompanying illustration we show one of the most powerful and promising ships that has entered the trial races. She is known as the "Elizabeth Howard" and hails from New York. This schooner, like the "Mayflower," measures up to the full limit of 112 feet on the waterline. Her main boom is 75 feet long, and the main gaff 48 feet. It will be noticed that she has a very marked sheer which carries up into a lofty bow, that should serve her well when beating to windward against a steep sea. The "Howard" was not built as a fisherman, but rather as a trading ship, and she has made many distant voyages, notably through the full length of the Mediterranean to Smyrna. As to her speed, her owner states that when fully loaded, and on a favorable point of sailing, she has logged 16 knots an hour in the open sea, and that close hauled she has done 13½ knots. We are inclined to doubt the correctness of the timing in the windward work; but there is no reason why, with her ability to carry her canvas in heavy winds, the "Elizabeth Howard" should not have done 16 knots on a broad reach.

It is probable that at least half a dozen of these splendid schooners will compete in the trial races. "Bluenose" is a fast schooner, and of about the same size as the "Howard," and the indications at present are that either the "Howard," or the Burgess-designed "Mayflower," will represent America in this most interesting contest.

Gliders and Gliding

(*Continued from page 299*)

dirigible could effect a landing anywhere without having to berth the huge airship. The glider is evidently more attractive in this connection than the usual parachute, and it may be that the glider will become to the dirigible what the lifeboat and raft are to the steamer.

Soaring flight has vast possibilities; and we have just scratched the surface, nothing more. The recent German record-breaking flights are due in large measure to exceptionally light construction of the gliders, and careful selection of the terrain over which the flights are made. Indeed, we are told that the German students studied the wind currents over the Rhön district for quite a while before the contest took place, testing the strength and direction of the winds by means of thistles. Then again, the pilot is an all-important factor. The pilot must know how the topography of the country under him is translated into wind currents, and then take advantage of these wind currents. Given a good glider, the skill and experience of the pilot will make all the difference between a short flight and a flight of indeterminate length and duration.

The main good that must come out of these sail-plane flights must be for aviation in general. Year after year we have gone on piling up horsepower in our airplane engines until today we have many two-seaters with over 400 horsepower. Compare that super-abundance of power with the low horsepower of the early two-seaters! Of course, our present-day machines are capable of great speeds, but from a practical standpoint they are too highly powered to make them commercially feasible. Some Englishman has remarked that the only parties making money out of commercial aviation are the gasoline purveyors.

But to return to our sail-plane contests: there must be a reaction in aviation design as a result of the marvelous gliding feats now being performed. We know only too well that many of our over-powered airplanes are poor gliders, and when the engine power fails, which it must at times, the machines drop at an alarming speed and there is grave danger involved. Furthermore, too much reliance on excess power has resulted in many aviation pilots of rather mediocre skill, for it takes greater skill to handle a low-powered airplane than a high-powered one. Such pilots, when called upon to volplane with a stalled engine, are often unable to perform successfully, having had too little or no experience in gliding flight.

The reaction of the sail-plane contests may be expected in aviation circles at no distant date. Designers have already stated that in the near future we may have airplanes of 10 horsepower or less, capable of safe and sure flight at a moderate speed, and quite capable of getting along without their engines to take advantage of favorable winds or through necessity.

Electrical Notes

Squirrels and High-Voltage Lines.—From Rochester comes word of the trouble that has been encountered with squirrels who will persist in becoming acquainted with high-voltage conductors. Short-circuits have resulted in the high-tension lines as the result of squirrels playing about the wires, with especially disastrous results for the squirrels. Now it is recommended that large tin collars be placed on the poles for the purpose of preventing the squirrels from reaching the wires above.

A Two-Filament Lamp.—There is nothing absolutely new in the idea of a two-filament lamp—a lamp with two separate filaments so that when the first filament burns out through accident or long usage, the second filament may be switched into the circuit. However, there has now appeared on the market a two-filament lamp in which the second filament is brought into play by pulling off a removable cap at the base of the lamp. The convenience of getting a second lamp out of a burnt-out one, not to speak of the economy, has made this two-filament lamp a favorite in the home and in industry.

Power House Figures.—On October 1, 1921, there were 5532 central generating plants in the United States with a total installed generator rating of 14,466,915 kilowatts, according to *Electrical World*. The total rating of the prime movers of the central stations in 1902 was only 1,818,413 horsepower, indicating an increase during the 19-year period of about 700 per cent. This is notably less than the increase in generator rating for the same period, which was about 1100 per cent. The total rating of the steam motors was reported as 13,331,933 horsepower, of which 86.5 per cent was attributed to steam turbines.

A Doorbell with Built-in Transformer.—From Germany comes an interesting electrical device in the form of a combination bell-ringing transformer and a doorbell which is suitable for operation on any alternating light circuit. On a peculiarly shaped iron core there are placed two high-voltage coils connected permanently to the light circuit and one 4-volt to 5-volt coil, the ends of which are carried over the self-interrupter of the bell to the push button, states *Electrical World*. To guard against overheating due to short-circuit in the low-voltage wiring, a strip of low-melting metal is used as connection between the two high-voltage coils.

A Peculiar Fatal Accident.—We are indebted to *Electrical World* for an account of a peculiar case of electrocution. A scrubwoman standing with bare feet on a wet floor touched the glass of an electric lamp bulb and was killed. Medical examination proved that death was due to electrocution. A very thorough investigation showed that the installation was in every respect perfect. Upon close examination of the lamp bulb it was found that there was a small streak of lime, extending from the brass of the lamp base along the glass for about two inches. This path was sufficiently conductive to pass enough current to kill a person, due to the high humidity in the room.

The Piezo-Electric Resonator.—A wide range of possibilities have been opened by the discovery that certain crystals change their electrical conductivity according to the pressure applied on them. In the course of experiments with piezo-electric crystals, as they are called, certain radio-frequency phenomena have been brought to light. The practical application of these phenomena is said to be worthy of development, according to the recent *Proceedings* of the Institute of Radio Engineers. The two applications which seem the most promising at present are: (1) as a frequency standard, (2) as a frequency stabilizer, or means of generating electric oscillations of constant frequency.

An Exchange of Power has been arranged whereby the municipal plants of the cities of Tacoma and Seattle, Washington, will exchange power in case of high demand or emergency conditions on the generating system of either city. The scheme of connections, although somewhat elaborate in design, is very simple in operation. The generating plant of each of the cities transmits power at approximately 50,000 volts. The maximum amount of power to be exchanged is 15,000 kv-a., and a 15,000 kv-a. three-phase, water-cooled transformer, having approximately a one-to-one ratio, will be used to tie the two generating systems together. One side of the transformer will be provided with a number of taps, and a tap-changing device will be supplied to vary the

How a Water Spray Increases Transformer Rating some 50 per cent is described in a recent issue of *Electrical World*. Three 100-kilowatt transformers at the Leesville hydro-electric plant in central Connecticut are installed above the forebay of the station and their output increased to about 450 kilowatts during the summer by a simple spraying arrangement. A one-horsepower motor drives a small reciprocating pump with intake from the forebay, and the water is discharged through a three-quarter-inch pipe running from the pump to the front of the transformer bank, a continuous spray being in action against the transformer casings. The water is returned to the forebay by a drain.

Improved Selenium Cells.—There has recently appeared on the market a new type of selenium cell which represents some fifteen years of research by F. V. Madaler. The new type of selenium cell is said to be the most sensitive yet manufactured. In fact, the passing of a pencil over a Madaler selenium cell on which the light of an electric lamp is shining will cause an appreciable fluctuation in voltage. This type has a resistance of 100,000 ohms in the dark, and 30,000 ohms in the light, in the experimental size. The Madaler selenium cell is not only highly sensitive, but it responds rapidly to changes of light, as compared with the usual selenium cells which are generally quite sluggish in action.

Interchangeable Fixtures.—A novel method of establishing permanent wiring facilities for lighting equipment in industrial plants, office buildings, public buildings, hotels, stores, hospitals, and so on, has just been introduced. The new method provides a permanent covering for the outlet box or fixture stud to which may be attached a wide range and free choice of lighting equipment to suit best any change in conditions or requirements. The new device makes permanent the wiring of the building and leaves the owner or tenant free to make any conceivable change in lighting equipment without in any way disturbing the wiring or terminal connections. Besides this outstanding and revolutionary advantage, the new device permits of the completion of all wiring, inspection and approval before the use of rooms or floors has been determined; easy removal of reflector or entire pendant unit for cleaning; change of lighting unit styles to fit changes in use of space illuminated; removal of lighting equipment during redecorating. A similar system of interchangeable fixtures has been on the market for some time past, although it is somewhat more complicated than the present arrangement.

The Resistance of the Human Body is a variable factor, according to an article in a recent issue of *Electrical World*. It depends largely upon the applied voltage, inasmuch as the resistance measured from hand to hand with precision instruments on potentials not in excess of 10 volts will show approximately 40,000 ohms, while if this potential is increased to 110 volts, the resistance breaks down to some extent and becomes nearly 10,000 ohms. The question naturally arises as to the reason for this difference of resistance in the same body under different potentials. This is explained by the high resistance of the epidermis. If the skin is removed from the human body and thoroughly dried, it becomes a very good insulator of high resistance, and under low voltage with dry contact the electrical pressure is not strong enough to break down the skin's resisting power, while, in the cases of high voltages through low resistance contacts, the epidermis generally breaks down, allowing the current to reach the blood and muscular tissues of the body. Due to the normal animal salts contained in the blood and muscular tissues of the average healthy person, which are, by virtue of their liquid and physical form, of very low ohmic resistance, excellent paths are available for the flow of heavy currents when the body is acted upon by medium voltages. The skin, then, is the main protection against electricity. If good contact could be established with the blood and muscular tissue, it is said that as little as 50 volts would prove fatal. With moistened contacts and with a potential of 2000 volts, such as are used with the electric chair, the body has a resistance of about 200 ohms.

Radio Notes

Combined Radio and Mail Service for Australia.—In an effort to extend the use of radio service in Australia, a system of radio transmission and mail delivery from steamers has been inaugurated by the Amalgamated Wireless. The radio company agrees to send out at the ordinary radio rate, plus 2½ d. postage on each letter, messages for mail steamers which have departed any time within the previous week. These radio messages will be written out by the ship's radio operator, placed in envelopes, and mailed at the particular port of call that the sender specifies.

Dutch East Indies Radio Station.—The installation of vacuum tube transmitters of 1200-kilowatt power and a Telefunken spark set for ship-to-shore work are nearing completion at Malabar. The high-power station is designed for direct communication with Holland. The corresponding station at Kootwijk will not be completed for several months. Radio telephone stations are being constructed in the Dutch East Indies at Soerabaja and Macassar. The radio telephone stations are not designed for broadcasting in the same way that this work is being carried on in the United States, since the stations are primarily intended for government use and not for amateur experiment purposes.

Alternating Current Supply for Amplifier Tubes.—There has been developed at the Bureau of Standards an amplifier which uses 60-cycle alternating current to supply power for both the filaments and plates. The necessity of storage batteries and dry batteries is thus eliminated. The final form of amplifier uses five tubes and a crystal detector, there being three radio-frequency stages and two audio-frequency stages. A description of this amplifier is contained in a paper by P. D. Lowell, which appeared in the July, 1922, issue of the *Journal* of the American Institute of Electrical Engineers, pages 488-490. It is expected that this paper will also be available as a publication of the Bureau of Standards in the near future.

List of Radio Stations.—Copies of the new list of Commercial and Government Radio Stations of the United States, edition June 30, 1922, will be ready for distribution about the 15th of October and may be procured from the Superintendent of Documents, Government Printing Office, Washington, D. C., at 15 cents per copy. The new list of Amateur Radio Stations of the United States will be ready for distribution about the same time or a few weeks later. The price of this publication is also 15 cents per copy. A list of the broadcasting stations in operation on June 30 last will be included in the first-named publication. The list of experimental stations, technical and training school stations, and special amateur stations (special land stations) will be in both publications.

Danish High-Power Radio Stations.—The commission appointed about two years ago by the Danish Ministry of Public Works to look into the question of a high-power radio telegraph station has now submitted a report recommending that necessary legislation be secured to permit erection and operation of a transatlantic radio station. The majority report favors installation of the Valdemar Poulsen are, while the minority recommends that selection of type be deferred, pending further investigation. In addition to commercial service to the United States and Canada, it is hoped to establish direct communication with Greenland. The report points out that the sooner the station is completed the greater the probability that a considerable portion of the radio traffic between the United States and Eastern Europe will be routed via Denmark and thus aid greatly in developing commerce between those countries.

Die-Cast Wood Horns.—The demand for loud-speakers has brought about the development of all kinds of horns, some of metal, others of fiber, and still others of pressed wood. It is the last-mentioned type with which we are momentarily interested. These are made of selected wood which is reduced to its original fiber and cast in steel dies under a pressure of 12 tons and subjected to 800 degrees of heat. This is claimed to form an artificial wood many times denser than natural wood. Its acoustic properties are remarkable. The vibrations received through the phone at the base of the horn are amplified by the rich, resonant vibrations of the material itself. The

metallic sound which is so annoying in many types of loud-speakers equipped with metal horns is said to be entirely eliminated.

Noiseless Mica Condensers.—Many of the troublesome noises in elaborate radio receiving circuits are due to imperfect condensers. To this end attention is now directed to the mica condensers which can be obtained in various sizes and capacities, and which eliminate the usual disturbances. The latest type of mica condenser represents a novel departure in condenser design. The outer casing is of seamless brass or copper tubing. The interior is built up after the best practice of alternate layers of clear ruby India mica and brass or copper sheets. The tubing is partially flattened and the condenser is inserted, after which powerful presses complete the operation by flattening the condenser into its final form. This process is claimed to produce constant and equal pressure over the entire plate area and does away with the troublesome noises. The metal case protects the plates and reduces hysteresis losses to a minimum. These condensers are said to withstand a potential of several thousands volts, if desired.

British Radio Licenses.—The British Postmaster General announces that formal license to conduct experiments in radio telegraphy cannot yet be granted; but pending settlement of certain questions, the use of receiving apparatus for bona fide experiments will be authorized to applicants of British nationality. Exceptions are made in the case of well-known foreign scientists if circumstances warrant. British citizens must submit proofs of British birth and furnish two written references as to character from British subjects of standing, not relatives. These documents, with the filled and signed application form and the initial fee of 10 shillings, are to be submitted to the proper authority. Permit to a company, society, etc., is issued in the name of the principal of that body, who is personally responsible for its observance. Minors (those under 21) may apply for and receive permits only through parent or guardian, each submitting birth evidence and references as above; the minor may work the apparatus as agent of parent or guardian. Messages, other than time signals, musical performances, and general information, transmitted by stations in Great Britain shall not be used or divulged to any person except authorized British Government officials or competent legal tribunal. The combined height and length of external aerial (where employed) shall not exceed 100 feet. Vacuum tubes, if used, must not be allowed to oscillate, even temporarily, so as to cause radiation from the aerial. The installation must be approved by the Postmaster General and be open to inspection by authorized officials at all reasonable times.

Radio Direction Finder Conference.—In response to invitations sent by the Bureau of Standards, representatives of nine companies interested in the manufacture of radio direction finders recently met to confer with the Assistant Secretary of Commerce, the Bureau of Lighthouses, and the Bureau of Standards, regarding the production, cost, installation, calibration, and maintenance of radio direction finders on shipboard. It was announced that the Department of Commerce has decided to install additional beacon stations as follows: Boston, Nantucket, Cape Charles, Columbia River, Puget Sound, and, if funds are still available, Delaware Bay, Los Angeles, and Blunts Reef. These are in addition to the two new radio beacons at Diamond Shoal (off Hatteras) and San Francisco light vessel. Three other radio beacons have been in operation in the vicinity of New York harbor for over a year at Ambrose, Fire Island, and Sea Girt. A considerable number of foreign ships have been equipped with radio direction finders and are calling for radio service as they approach American shores. American shipping companies appreciate the importance of using the radio direction finder on shipboard in order to determine their locations in time of fog and in order to aid in various ways in time of distress at sea. As a result of the conference arrangements will be made through the Bureau of Lighthouses, between the manufacturers of radio direction finders, and the operators of steamships for the trial and demonstration of radio direction finding equipment under conditions of practice. It is anticipated that with the installation of the additional radio beacon stations, and the activity of the manufacturers in the production of direction finders for use on shipboard, this method will be adopted very generally as an aid to navigation.

When Gears and Levers Replace the Cigar Maker's Adept Fingers

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softening effect implied by the name is achieved. The rotation of the roller provides the force necessary to carry the bunch around to position G, where it undergoes another transfer. It is picked up by the transfer arm 21 and carried through the dotted-line path into the crimper 23. Here the crimper jaws 24, 25 come together on the bunch and effect a further shaping, especially of the tapering ends.

From its position H in the crimper jaws (passing to plate C, where these jaws are seen open to permit the removal of the bunch), the next transfer arm picks the bunch up and carries it through the path 27 to the position I, where it rests upon rotating rollers not well shown in the drawing. In the meantime, the wrapper has been prepared. It has to be cut to shape rather carefully. A third operator, at another side-station not shown in the drawing, takes a large wrapper-leaf and lays it over a flat die of the exact shape desired. Suction operates over the entire surface of this die but not beyond, and this makes it easy for the operator with a dexterous sweep of the hand to tear off the wrapper leaf exactly along the edge of the die. The suction arm 30 then picks up the wrapper just as arm 17 has already picked up the filler; and it makes a long reach across the machine to come into the position 30, which it attains just as the crimped charge comes to I. The arm 30, carrying the wrapper along its under surface, then moves straight forward (to the left), gum being applied to the proper edge of the wrapper as it advances. The rotation of the bunch in contact with the forward-moving wrapper, coupled with the release of the suction that held the latter on the under face of the arm 30, effects the winding of the wrapper around the bunch.

Finished except for final shaping, the cigar is now raised from I to K and engaged by the transfer arm 32, which carries it around as indicated and drops it between plate 33 and roller 34 for another whirl at the shaping game. This roller has a back-and-forth motion, going further on each forward rotation than on the preceding backward one, so that the cigar is more thoroughly rolled, but gradually worked down to position L. Here trimmer knives 36, 37 clip off the ends to the desired length, while a head-knurler (out of sight behind the other mechanism) smooths off the blunt end. The cigars are then dropped to the table 39, where they are given a final examination by a fourth operator. Those few which reveal defects go back to the filler table A and become part of the incoming charge again. The rest are bundled and tied by hand, the operator having just about time to do this as the cigars reach her, one every seven or eight seconds.

The whole machine, it is to be emphasized, is a single unit, in spite of our division of it into three for convenience of description. With the four operations, production runs from 3400 to 4200 cigars per day, according to size and the extent of stoppages. This reduces costs greatly over those of hand-made cigars. That the machine is no untried experiment is indicated by the fact that over a billion cigars were made on it during 1921.

Another Step Forward in the Phonographic Art

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tone. Hence spruce is free from the inherent faults of mica. Dr. DeGans has made use of violin spruce, which reproduces tone with a volume and purity that are truly surprising. In every fiber of violin spruce are suspended innumerable diaphragms, almost infinitesmal in size. Under the high-power microscope these minute diaphragms are revealed as perfect sounding boards, all vibrating sympathetically.

The SCIENTIFIC AMERICAN has had a large number of phonograph reproducers submitted for test—some with special mechanical mounting, others with paper and cardboard diaphragms, still others with ivory, gold-plated silk, cork, celluloid, bakelite, hard fiber, and so on. But so far the DeGans reproducer is by far the best that has come to our attention. Difficult recordings such as the 'cello, the piano, an orchestra of many pieces, the banjo, and others are reproduced with remarkable clarity. There is none of the blurred, mushy rendition so common in many phonographs, and a special construction of the stylus arm and trunnion bearings has evidently eliminated blasts or shrill notes in this new reproducer.

Annual Subscription Rate

Scientific American (established 1845) one year.....$4.00

Postage prepaid in United States and possessions, Mexico, Cuba and Panama

Foreign Postage.....$1.00 per year additional

Canadian Postage.....$0.50 per year additional

Remit by postal or express money order, bank draft or check.

When Optical Illusions Aid the Engineer

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point of a cycle instead of broken. Making the circuit, which is supplied with current from a secondary battery, illuminates a special handlamp, and the machine is then examined by flashes of light from the latter. If the oscilloscope controls the flashes so as to give one flash every revolution of the mechanism, exactly when that mechanism is in a certain position, persistence of image will cause the whole mechanism to appear to be stationary in that position. If the oscilloscope gear box be advanced or retarded in the same manner as an ignition magneto, then this stationary image of the mechanism can be produced at any point in the cycle.

There is another phase in the use of the oscilloscope which is called the "creeping position" or "creeper gear." When this is in use, a flash takes place at every revolution as before, but not always in the same place. The creeper gear, consisting of wheels of 100 and 101 teeth in mesh, causes each flash to be delayed 1 per cent in angular displacement. In 100 such flashes, the machine under examination will therefore have gained one complete revolution. It will appear to have made one complete revolution, although it has really made one hundred. In other words, the optical gear-ratio thus produced has slowed down the real motion to the eye.

Some most striking observations can be made with every kind of high-speed machinery. The action of the valves of an auto engine may be examined at 3000 revolutions as leisurely as if they are acting at 30. But the bounce and other phenomena present at the high speed and not at the low can be most clearly seen. A sewing-machine at high speeds will show alarming bends and kinks in an apparently rigid needle. The problems of vibrating shafts, and indeed of any other high-speed machinery, may be solved visually by the oscilloscope, instead of mathematically by the engineer. He can *see* what is happening, instead of conjecturing!

Our Chinese Customers

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American office will enable the manufacturer to talk over matters face to face, settle many details without loss of time and give a close and personal contact not otherwise obtainable. There is also the great advantage of reducing credits, accounts, shipments, in fact all dealings. In employing the services of such a firm, the manufacturer, however, should never surrender the control of his output. He should reserve always his rights to augment sales by advertising or additional sales devices, set a time limit to the contract, specify the minimum amount to be sold in a given time, etc.

As the majority of Chinese are illiterate the "chop" or trade-mark plays a more important part in the selling of goods than it does in this country. Here, it is safe to say, unless a trade-mark is heavily advertised the average individual buys by name, or title. In China, the illiterate buy through the eye. That is, if they see the advertisement of, or are shown, a packet the contents of which appeal to their needs, they will go to the nearest store and point to the similar packet. They have an ability all their own to carry in their mind, down to the finest detail, a picture that they have seen. Let the packet in the store vary only in a slight degree from that which has been shown them as a sample and they will refuse to buy. The advantage of a distinctive and simple "chop" is therefore apparent and the American manufacturer who is going to introduce his goods in China should employ such a mark.

While undoubtedly English is the language of commerce in China for international trade, an overwhelming majority of the Chinese speak only in the vernacular. China proper, with its eighteen provinces, each with its own dialect, has been forced to use some common medium of language; and among the educated, Mandarin Chinese is employed and a general appeal to the Chinese public must therefore be either in Mandarin Chinese or in the dialects of the provinces. The English language, however, may be used to advantage in certain restricted lines where the appeal here is either to the highly educated Chinese or to the foreigner in China.

Hypnotism—Fact or Fake?

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These are in the form of amnesia, or forgetting. As a general rule the subject is amnesic for everything that has gone on while he was in the hypnotic state.

Closely related to the amnesia of hypnotism is post-hypnotic suggestion. Within certain limits, anything that the subject is told, while hypnotized, to do after awakening, he will do when and as instructed, without knowing why he is doing it and often to his considerable bewilderment to understand why. The only line that he will draw is against a thing which would offend his moral sense. If he is not a murderer he will not commit murder under post-hypnotic suggestion, if he is not a thief he will not steal save as a prank. But his mere sense of the fitness of things will not save him; he will, if so instructed, and regardless of his own feelings about it, order delivered to his fiancée, with his card, a gross of nursing bottles and an assortment of baby carriages.

Under the proper suggestions the hypnotic subject can be rendered insensitive to pain. This is closely related to the negative hallucinations. He may have his flesh pierced with pins and burned with hot metals, but still he does not flinch; apparently he feels nothing. Severe surgical operations have been performed with no anesthetic other than hypnosis. Hypnosis in itself does not make the subject insensitive to pain. But suggesting that nothing will be felt in the right arm will render that part of the body anesthetic. The bed of sharpened spikes upon which the Hindu ascetic rests for the cleansing of his soul probably pierces the flesh of an anesthetic subject, rendered so by auto-hypnosis, or self-hypnosis.

Through hypnosis, or through auto-hypnosis, the subject may also be rendered hyperesthetic. This is just the opposite of anesthetic. Instead of no pain being felt every little jar and scratch brings about apparently intense agony. Auto-hypnosis is commonly observed by dentists, and it is usually accompanied by hyperesthesia. A dentist friend was relating the instance of a rather ignorant woman upon whom he was operating, who was extremely hyperesthetic. Merely bringing the drill into contact with her teeth threw her into agonizing pain. He could make no progress at all with the work—until he used suggestion. He measured out a peppermint-flavored concoction, highly colored and flavored. He held a watch while the patient retained this in her mouth for three minutes. He told her that it was trinitrotuluouene and would deaden all pain whatsoever. She might as well have held soft soap in her mouth so far as deadening the pain was concerned; the pains were not localized in her tooth, they were farther back, near where her imagination was located.

The dentist's chair, with the monotonous grinding and queer articles for fixating the attention, is a splendid place for bringing about auto-hypnosis. I know. I am taking dental treatments right now and have tried it out. I have managed to bring about anesthesia, much to my comfort and to the admiration of the dentist. I have him fooled; he thinks I have lots of nerve.

The suffering from certain diseases has frequently been relieved by the use of post-hypnotic suggestions. While hypnotized the patient is told that after awakening the pain will gradually become less and less noticeable until after three days there will be no discomfort noticed. Of course this does not cure the disease or remove the trouble. It merely makes it more bearable.

The muscular changes that accompany the hypnotic condition are remarkable. Many instances of almost superhuman strength are recorded. A peculiar muscular rigidity is characteristic of the deeper degrees of hypnosis. The subject's arm is raised by the hypnotist. The operator then tells the subject that he cannot move his arm. And, sure enough, the arm is stiff as a rod of steel. This condition of *catelepsy* will persist much longer under hypnosis than it would ever be possible for the subject to hold his muscles rigid in more usual conditions. Eastern religious devotees hold their arm above their head for month after month until it becomes a matter of years. Will power? More likely catelepsy brought about by auto-hypnosis, if not through genuine hypnosis in the shrine.

One of the most peculiar characteristics of hypnosis is that the subject will obey only the suggestions and commands of the person who hypnotized him. There is a *rapport* between the hypnotist and his subject which does not exist between the subject and other people. Still there is nothing of the supernatural about this. Everyone has a certain degree of rapport between himself and the members of the family or his friends. In hypnosis this is carried to the extreme. Only the hypnotist can be successful at getting the subject to do what is wanted.

Eliminating Static by Means of the Resonance Coil

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less equipment," and is adaptable to service in the absence of "ground" connection, either actual or counterpoise. As a transmitter, the device tunes its own waves and is a single-unit direction finder.

The experimental unit of the "resonance-wave coil" built by the Signal Corps is of a hollow cardboard design, 38 inches long and 3¾ inches in diameter, around which was threaded a single layer of No. 32-gage insulated wire. This afforded 100 windings to the inch. Terminal binding posts are placed at each end of this tube or coil. A brass band or ring, a fixture of the compact antenna, is supplied with the binding post. This ring in its formation is interrupted by a split one-fourth of an inch wide at a point opposite to the binding post. This break avoids interference from disturbing eddy currents. The ring is of ample size to slip over the wired tube. The coil is pivoted to swing to any angle in the vertical plane. A dial on the base of the framework indicates the compass direction of the tube. Another dial, facing the operator, reflects the degree of elevation.

A "resonance-wave coil" of the dimensions indicated is capable of receiving signals ranging upward to a wave-length of 1200 meters. Contrary to the operating principle of former designs of tuning coils, the shortest wave point on this device is at the center of the coil. If the tube is in a position exactly at right angles to incoming electro-magnetic waves, the brass ring can be moved toward either end of the coil as a means of tuning to the incoming signals. Putting it differently, there are two points along the coil, located at equal distances from its center toward either end, where 600-meter wave-lengths will be audible. By the same token, at two points a bit further along on both ends of the coil, 750-meter wave-lengths may be received. When the tube was located in the Washington laboratories of the Signal Corps, wireless signals from the radio-telegraph station of the United States Navy Department in Cuba could be heard distinctly. The reduction of static electricity to a minimum by the use of the "resonance-wave coil" inspired the Signal Corps to apply the principles of this device to the development of the "static eliminator" discussed in the preceding paragraphs of this article.

Our Strenuous Geological Survey IV

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miles long"—which they did. But two men, with the last canoe, declared that they would like to try running the rapids of the canyon inasmuch as all the instruments and other paraphernalia had been safely carried around, and any disaster which they might encounter would therefore be strictly "their own funeral."

Permission being granted somewhat reluctantly, they started the canoe down the rapids. These consisted of a succession of sudden drops followed by stretches of comparatively still water, and rapid after rapid of boiling water and foam was safely negotiated until suddenly, at the bottom of a steep drop of water where the current was running at prodigious speed, there appeared in the middle of the channel a huge rock as big as a house against which the current dashed and foamed. The canoe shot downward and appeared to be headed straight for destruction. Just as the frail craft was about to smash into the rock the bowman jumped for it, sacrificing himself, but thus kicking out the bow of the canoe, which swung out to one side and in a second shot by. In the relatively slack waters below, about the first thing the frightened steersman discerned was a grinning face which bobbed to the surface beside the canoe, followed by a lanky and dripping body, which quickly climbed back into it. The current shot the canoe into the next rapid, and eventually reached the lower end of the canyon, where the two adventurers joined the rest of the party and proceeded to "carry on" as usual. The running of rapids and river disasters were all in the day's work and but added to the spice of life in the Far North.

Thus ends the story of the Geological Survey—its methods and its intrepid men. You are no doubt familiar with the product of this branch of the Government, in the form of the highly detailed maps of various sections of the country which are obtainable at such an absurdly low price. And now you know the story behind those maps.